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Vol. XLII

FLIGHT

and The AIRCRAFT ENGINEER

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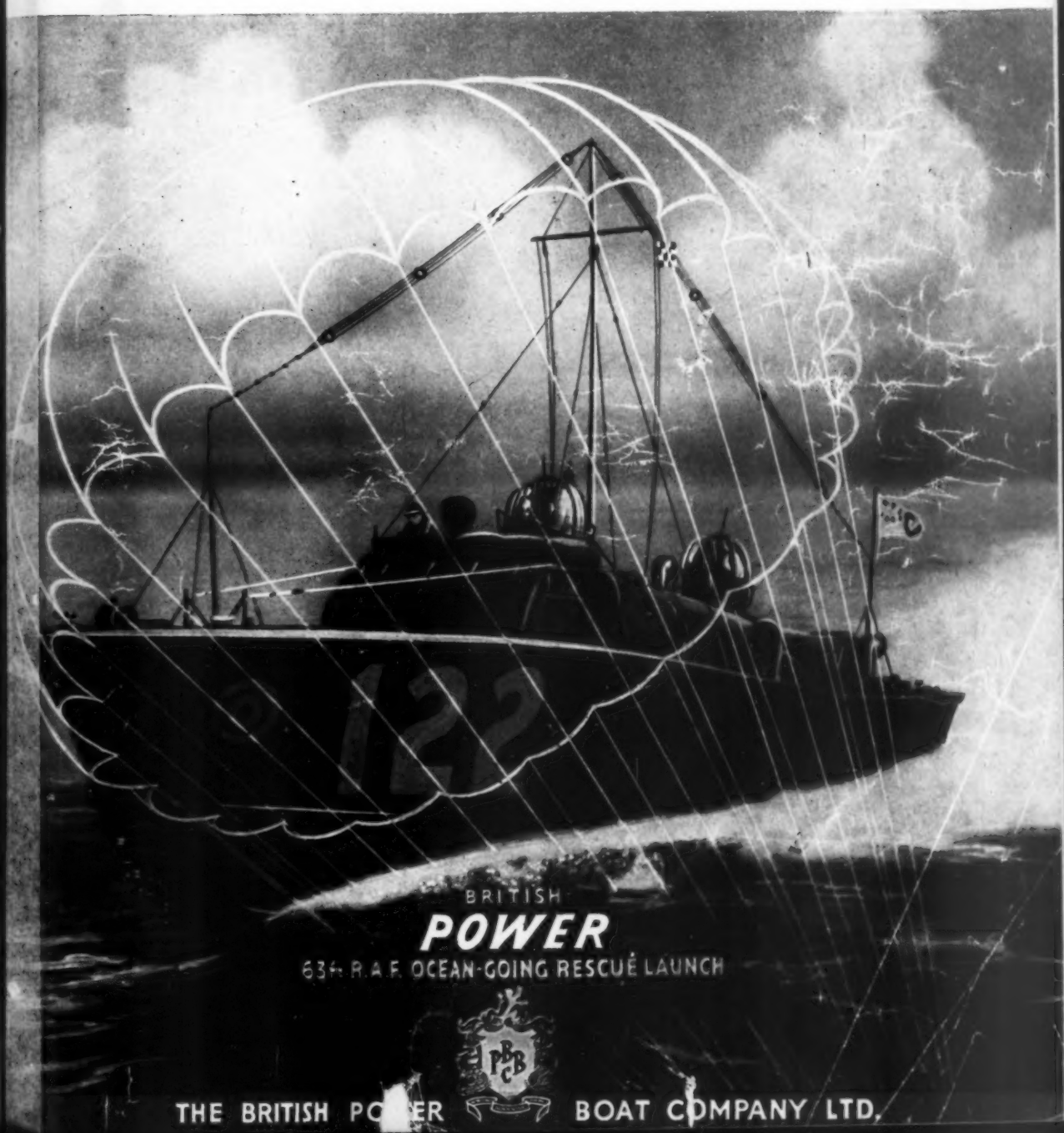

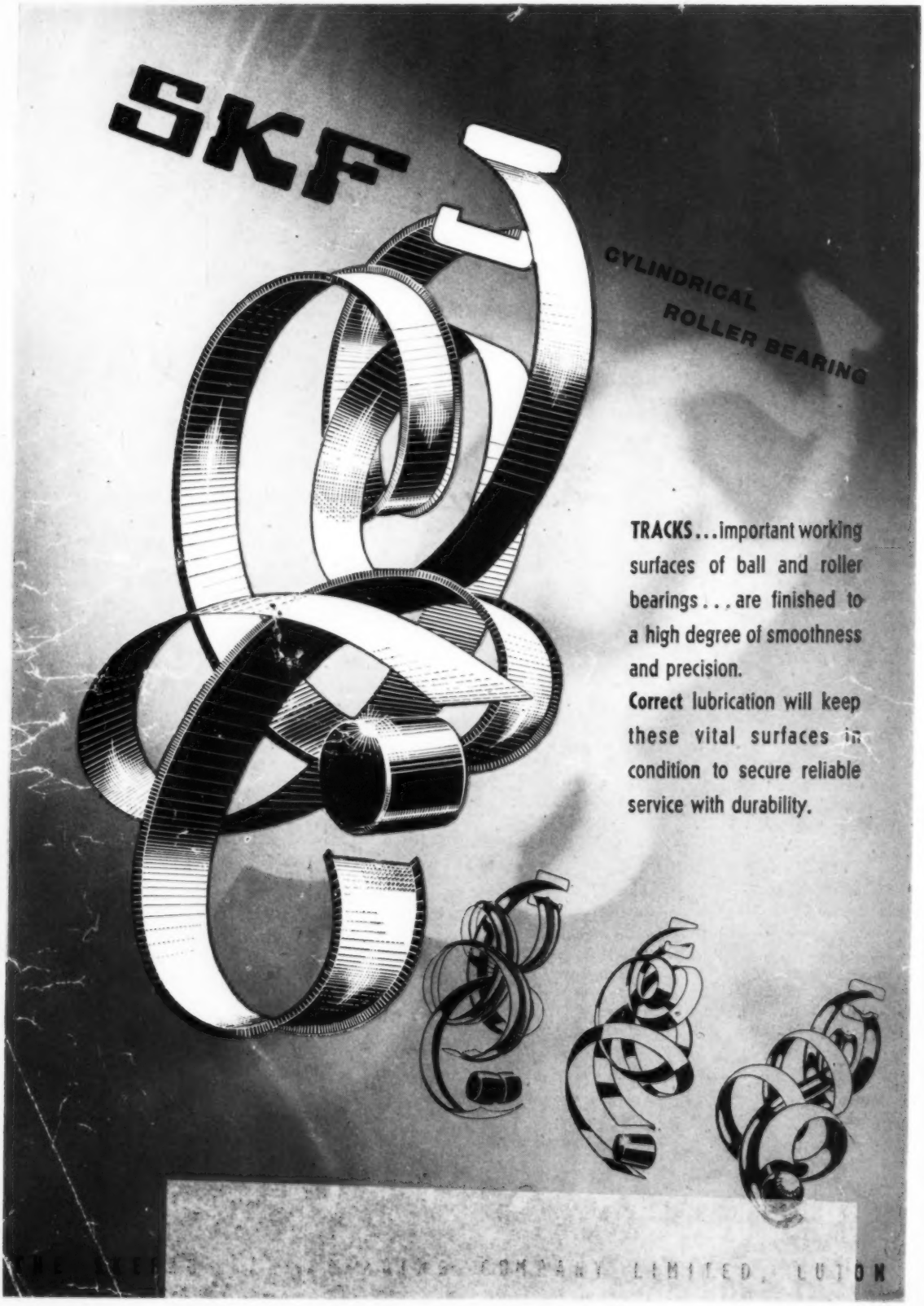
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FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

Test Pilots

ONCE again "Indicator" returns, in this issue, to the subject of test pilots and their status. A reader outlines, on our Correspondence page, what he thinks ought to be done in the matter; and from yet another reader, who does not wish his letter published but who does not object to being quoted, we have received certain views. This reader suggests that, as the job of a manufacturer's test pilot is to test prototypes, he ought to be more than half of an aircraft designer; he should be of such status and experience that he can talk to senior officers of the R.A.F. on their own level, and ought to be paid about the same as an Air Commodore or an Air Vice-Marshal. "He must," this reader says, "stand well enough with the head of the firm to be able to stand up to the designer and the works manager and tell them where they are wrong."

A Flight Lieutenant of the Reserve of Air Force Officers proposes (in our Correspondence columns) that the Society of British Aircraft Constructors and the Guild of Air Pilots and Navigators should call a meeting of firms' test pilots, and possibly representatives from the Aircraft and Armament Experimental Establishment, to draft a grading of test pilots, rather in the manner of the Central Flying School.

"Indicator," in his *Topics of the Day*, apparently would be content with a pool of test pilots from the subsidiaries and main firm of the large manufacturers, and thinks that this relatively simple remedy would ensure that no prototype got through without certain faults coming to light which might escape detection where only one or two pilots had tested the machine.

All this is apt to convey the impression that our whole system of test-piloting needs overhaul, and that, because he is in the pay of the designing and producing firm, the tester of prototypes cannot be ruthless in the eradication of faults, irrespective of cost and consequences. To us it appears that such a state of affairs is very far from existing. For one thing, the designing firm has its reputation to consider. And even putting the matter on no higher a plane than the financial, it is a whole lot cheaper to make even radical changes in the prototype stage than it is to make modifications once the production stage has been reached. Consequently there is every reason for "getting the bugs out" as early as possible.

That is not to say that *something* could not and should not be done to improve what is already a reasonably satisfactory system, and we rather like the suggestion of an S.B.A.C./G.A.P.A.N. conference with the test pilots of the country.

Round-about

THE old sage proclaimed that the shortest distance between two points is a straight line connecting the points, but it is rather curious how often in the evolution of the flying machine the indirect rather than the direct approach to a problem has proved the quickest route. Inventors were hard at work on the helicopter (that is to say, the direct-lift type of aircraft) at much about the same time that Wilbur and Orville Wright began to study flight by fixed-wing aircraft (that is, the indirect way of getting lift). The Wrights succeeded, and the helicopter was side-tracked for years.

How very indirect is the modern method of lifting people and goods into the air is not, perhaps, generally realised. We have become so accustomed as to take it for granted. The most direct form of flight is that represented by the rocket, in which the fuel is burnt

and the reaction gives both lift and propulsion.

Not so with our modern aircraft. The fuel is mixed with air in a complicated carburettor; the mixture is pumped into a cylinder in which a piston travels up and down; the piston exerts a force on one end of a connecting-rod, the other end of which bears on a crank and turns it; on the crankshaft is a gear which engages with another gear on the airscrew shaft, and even so we have only begun our roundabout search for lift.

In the old days, we had almost finished the journey when we got as far as the airscrew shaft. Nowadays we have more gears, or cylinders, or cams, between the airscrew boss and its blades. When we get past them we blow a bit of air back, but still not to get direct lift. Oh, no. We blow the air back so that we can drag a wing forward, the wing, in turn, being a form of gear in which, for a pound of drag, we hope to get fifteen pounds or so of lift. Could anything be more delightfully indirect than that route from exploding charge to lift?

Flight has, more than any journal, probed the possibilities of shortening the long way around by using forms of propulsion alternative to the reciprocating engine-cum air-screw-cum fixed-wing combination. This week we continue with another article on the subject, this time dealing with combustion gas turbines driving airscrews. There is a long way to go yet before we reach the practical stage, but the possibilities are intriguing, and it is well not to forget the beautiful simplicity of Hero's simple steam globe, which was the first crude step towards direct propulsion.

Fighting Bombers

LAST Friday's daylight raid by American bombers should give our air tacticians furiously to think—unless, of course, some facts have not been published which would explain the happenings. The main facts which appear are that 115 Fortresses and Liberators went to attack engineering works at Lille from a high level, and that nearly 500 fighters went as escort and also to make diversionary sweeps over neighbouring airfields.

From such a disposition of forces one would expect that the bombers would be almost entirely immune from attack by enemy fighters, but that their fighter escort would be heavily engaged, and that the latter would come home with a long tale of victories to its credit, and probably some losses. That did not happen. The Spitfires (there may have been other fighter types, but the bulk would certainly be Spitfires) suffered no losses and only shot down five enemy aircraft for certain, though they probably accounted for more.

On the other hand, the bombers were heavily attacked. They actually shot down 48 fighters with their own machine-guns (mainly of the 0.5 calibre), claimed 38 as probables, and 19 more as damaged. These figures were published after more than 1,000 members of the crews had been interrogated and their reports cross-checked. That shows that at least 105 German fighters came within range of the American guns, and, of course, there must have been many more which escaped. The Americans lost only four bombers. In fact, the bombers wiped the eyes of the Spitfires.

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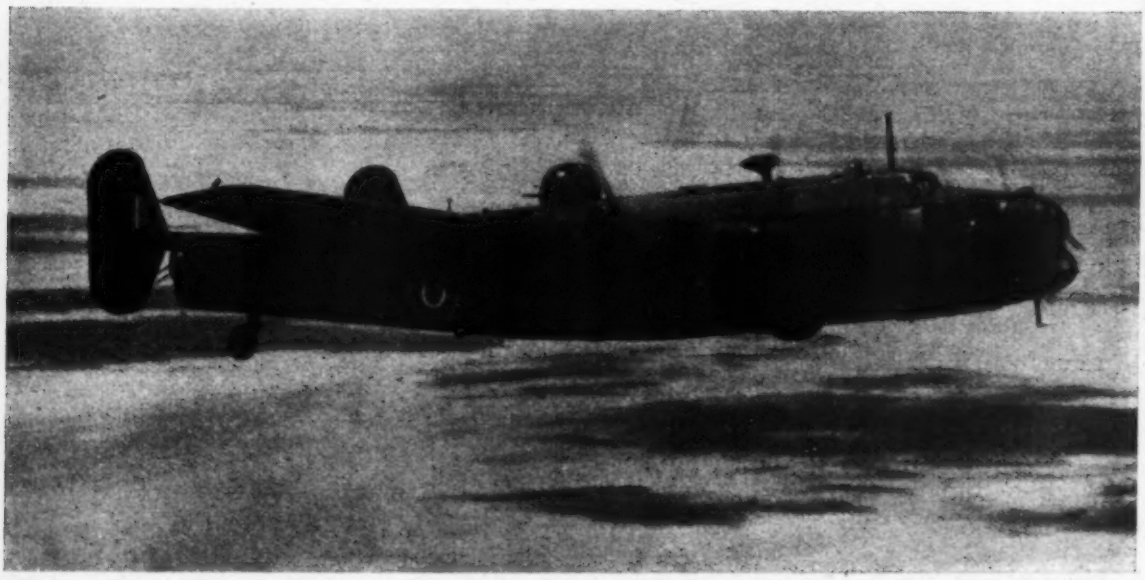


MIDDLE EAST HEAVYWEIGHT: A Handley Page Halifax operating over the Western Desert. On pages 424-427 is a series of 28 exclusive photographs showing some of the many ground tasks necessary to keep one of these heavy bombers flying.

War in the Air

The four Hurricane IICs, presented by Lady MacRobert in memory of her sons, flying in the Middle East.

September Records : The Stalingrad Struggle : More Mosquito Raids : Australian Advance in New Guinea

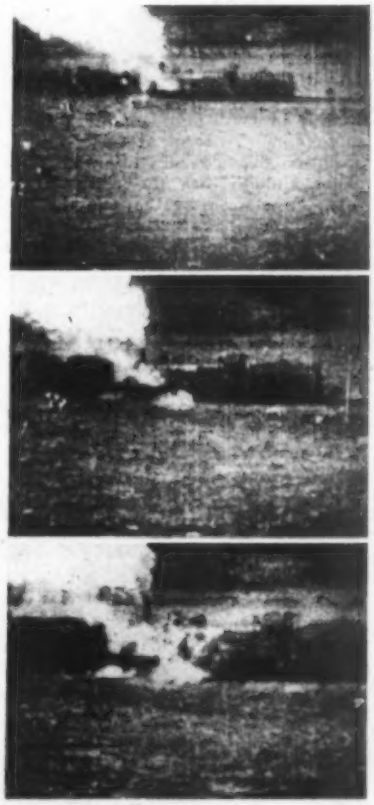
BOMBER Command is steadily increasing its power to work on dark, moonless nights. During September it made a special effort to do what it could to relieve the pressure on Stalingrad, and in the first twenty days of the month it made no fewer than twelve night raids, in the course of which between 5,000 and 6,000 tons of bombs were dropped on Germany. Then the weather got too bad, and in the last ten days of the month only two night raids were made. During the height of the "blitz" in the winter of 1940-41 the Germans sent their bombers over Britain every night for a considerable time, regardless of the weather. It did not pay them, and when they realised that they abandoned the practice. Bomber Command aims at sending out bombers whenever there is a fair prospect of getting results which are worth while, but makes no hard and fast rule that there must be operations every night regardless of the weather. To its actual bombing activities must be added the amount of mine-laying done, which is less spectacular but pays good dividends. A feature of September's work was the adoption of the 8,000 lb. bomb as a standard weapon.

In addition to the night bombing, the daylight raids should not be forgotten. So far, they have been on a small scale, and may be classed as harassing raids, but they are certainly useful. The raid by a small force of Mosquitoes on Oslo was notable, for that type of aircraft is very suitable for this sort of work. The Germans have found, as we found a long time ago, that it does not pay to send everybody to underground shelters whenever a day warning sounds, thereby holding up all production and the general life of a place, and have more or less copied the distinction which has been made in Britain between an "alert" and a more serious warning. Another novelty of the month of September was the use of Whirlwinds carrying bombs.

Some Results

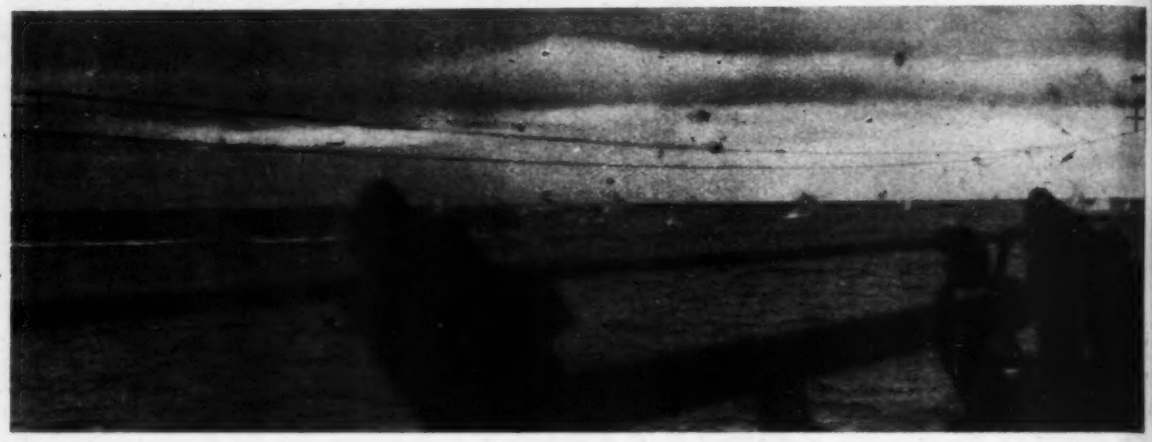
IT has to be admitted that bombing in the West cannot immediately affect the number of German bombers used on the Eastern front, but it must have an effect in the long run, and it certainly keeps German fighters, as well as all the men needed for an elaborate defence system, tied down in the West when they would otherwise go to increase the forces used against the Russians. The raids by day and night carried out by Fighter Command give additional reasons why the Germans must keep a strong force of Focke-Wulfs and Messerschmitts in the West.

The Middle East has put up a fine record in the autumn. The Allied air forces raided Tobruk on 95 nights out of the first hundred since the place fell into the hands of the Axis. In these raids 4,000 tons of bombs were dropped and caused great havoc among the shipping in the harbour. Of course Benghazi also came in for lots of attention, and ships *en route for* Africa were regularly harried by aircraft as well as by submarines. During September 40 Axis vessels, including



TRAINED GUNS : Three photographs taken by the synchronised cine-camera as a Polish fighter pilot made a cannon attack on a goods train in Northern France.

WAR IN THE AIR



IN LATITUDE 72 NORTH : A scene during an attack by Junkers Ju 88s on a convoy of supplies for Russia ,on the way to Murmansk.

U-boats, E-boats and *flak* ships were sunk or damaged by air attack alone in all theatres of war.

In the West

THE happily named Mosquitoes have been out again biting the Germans and drawing blood from tender spots. They have been working by day, often just before dusk, usually in small numbers and without any escort. Their speed makes it hard for the defences to interfere with them, though they fly farther afield and run more risks than do the tip-and-run raiders of the *Luftwaffe* which have been dropping bombs on places near the coast of England. One Mosquito raid hit a factory near Hengelo, which is 100 miles inland from the Dutch frontier, while others have penetrated elsewhere into western Germany.

The heavy machines of Bomber Command go out every night when the weather offers a prospect of useful results, and on one very dark night lately Osnabrück was treated to three-quarters of an hour of concentrated bombing.

It is interesting to note that a newly formed squadron of French Canadians has been taking part in the night raids. These men are fighting, not only for the Empire to which they are proud to belong, but also for the freedom of the land from which their ancestors hailed.

The Eastern Front

THERE are indications that the Russians have succeeded in getting fresh troops up to relieve some of the exhausted defenders of Stalingrad, and a prolonged German assault, which had the appearance of a supreme, almost despairing effort, seems to have been effectively halted. The Russian counter-attack to the north of the city has made only slow progress; but it has possibilities which the Germans cannot overlook, for it might develop into a serious threat to the left wing of the troops which are attacking Stalingrad. The Germans still hold air superiority, and are using it to the utmost wherever it is possible to do so in the rôle of field artillery. With worse communications behind their lines, it is not easy for the Russians to move squadrons quickly from point to point as the Germans can do. The latter have also difficulties of communications, and rely a great deal on transport aircraft. It is not claimed that this is so effective as rail transport, but it becomes very useful when the troops have advanced far beyond the railways.

It is notable that German broadcasters have begun to say that the actual storming of Stalingrad is no longer necessary, as their troops have (so they say) reached the Volga.

The fighting round Leningrad has recently flared up again, with the Russians holding the initiative. On this front it is stated that both sides have recently been using new types of aircraft, and, in particular, good work has been done by the new Stormovik ILL 2. No details of this machine

IN LATITUDE 10 SOUTH : A scene during an attack by Japanese twin-engined OB-01 torpedo bombers on a U.S. warship during the landing of the American marines in the Solomons.

WAR IN THE AIR

ENEMY AIR LOSSES TO OCT. 10th

	Over G.B.	Over Continent	Middle East
Oct. 4	0	0	0
" 5	0	0	0
" 6	0	0	1
" 7	0	0	2
" 8	0	1	0
" 9	0	53	24
" 10	1	0	2
	1	54	29

Totals: West, 6,426; Middle East, over 4,624.

have yet been released for publication by the Russians.

STILL THEY FALL: A Heinkel III brought down by the Russians in the Rzhev area.

A Surprise Raid in Egypt

FRIDAY, October 9th, was a busy day and night for the Allied air forces in the Middle and Far East. In Egypt things had been fairly quiet for some time, chiefly due to unfavourable weather, but on that Friday the Eighth Army staged two of the biggest daylight raids in which it has ever indulged. The main, but not the only, targets were the enemy's airfields in the low land near the sea. There seems little doubt that the object was to interfere with Rommel's plan to build up his air strength until it equals or surpasses that of the Allies. First, the British and Allied bombers made their attack, coming in from the sea, and evidently taking the enemy by surprise. Many of the Axis landing grounds were water-logged. Gun positions and transport were also attacked, and some pilots said that they had seen enemy gun crews gaping open-mouthed upwards. Numbers of Germans were shot down before they could take any action.

After our bombers had prepared the way, our fighters went in, making low-flying attacks. Wave after wave, they flew over the Axis positions, and did great damage. After the first surprise was over, enemy fighters took off, and there were many dog fights. We claimed ten enemy aircraft shot down in the air and 14 destroyed on the ground. It sounds a very modest claim, but that is in accordance with R.A.F. policy. Almost certainly we must have done a great deal more damage than that. Our losses that day were twelve machines.

East of Suez

ON the same day General MacArthur's aircraft made the heaviest attack so far made on the Japanese main base at Rabaul. First of all Australian Catalinas flew over the target by night and dropped fire-bombs to light it up. Then, before dawn, a large concentration of Fortresses followed on and dropped 60 tons of bombs. On the next night the Fortresses went there again, though in smaller numbers, and dropped another 40 tons. On the Friday Hudsons flew to the Tenimber Islands and completed the destruction of a vessel which they had attacked the day before.

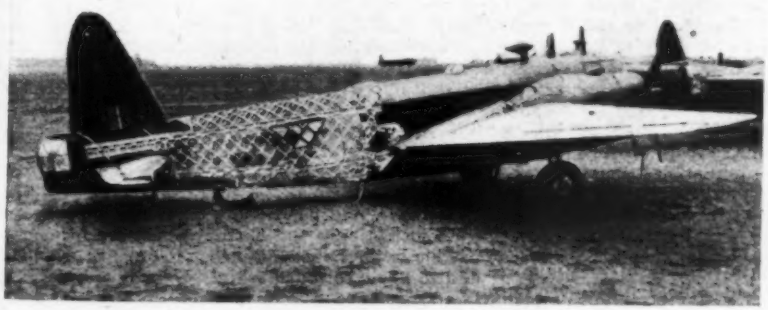
The Japanese have landed some reinforcements on Guadalcanal Island in the Solomons group, but at a price. Dive-bombers and torpedo-aircraft of the U.S. Navy and Marine Corps attacked the ships which were bringing them and sank a destroyer, besides damaging another and also damaging a cruiser with both bombs and torpedoes.

BRITISH & U.S. AIR LOSSES TO OCT. 10th

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent F'trs.	Middle East A'rcft.
Oct. 4	0	0	0	1
" 5	0	10	0	0
" 6	0	6	0	4
" 7	0	0	0	1
" 8	0	0	0	1
" 9	0	5	0	12
" 10	0	0	0	3
	0	21	0	22

Totals: West, 4,744; Middle East, about 1,747.

In New Guinea the Japanese have withdrawn in front of the advancing Australians. The latter have followed on, but for some days could not catch up with the enemy, and only occasionally had brushes with his patrols. The reason for this Japanese withdrawal is not yet apparent, but that it was hurried is shown by the amount of valuable material which they left behind for the Australians to pick up. Airacobras and other low-flying aircraft have been consistently harrying the Japanese lines of communications, and the enemy may have found his supply difficulties too difficult to make it possible to advance or even to maintain his positions.



DRAUGHTY: A Wellington which was hit by an A.A. shell over Bremen. The fabric covering caught fire but this was extinguished by the rush of air in a steep dive. The rear gunner stayed in his turret!

Fortress Fighters

YET another "biggest to date" event must be recorded this week. Fortresses and Liberators of the Eighth American Army Air Corps made the largest daylight raid of the war with Lille as their target. A very large escort of Spitfires went with them. Despite this, Fw 190 and Me 109 fighters managed to attack the bombers, which claimed to have shot down 48 for certain, besides 38 probables and 19 damaged. The escort and diversionary fighters accounted for five more. The Americans lost four bombers, but the crew of one was saved.

Topics of the Day

POINTERS TO PERFECTION

Stressing the Vital Importance of the Test Pilot : The Difference Between Routine and Prototype Work : Introducing Varied Experience and Open Minds to Initial Development : A Mixed "Pool"?

A WEEK or two ago the somewhat aimless chatter on this page wandered on to the subject of test pilots and their somewhat anomalous position, so to speak, between God and Mammon. This particular nonsense had, naturally, been written a week or two before it actually appeared in print, and it was distinctly encouraging to read, in the interval between production and publication, a letter in the correspondence columns dealing with the same subject and voicing more or less the same doubts.

In fact, things work pretty well as they are, and nine out of ten test pilots are as honest and rigorous as they could possibly be expected to be in a somewhat disappointing world. But there is no reason at all why the figure shouldn't be ten out of ten and why the other nine shouldn't be freed from what the correspondent so aptly called "economic and politico-domestic influences." Of course, he cannot be entirely freed from such influences.

Generally speaking, nearly all firms are pleasant to work for, and the most vitally individualistic and Air Ministry-minded person must inevitably come under the influence of the various individualists who make up a "firm"—*if* each test pilot is permanently attached to that firm; and there is no reason why he should be. The ordinary R.A.F. pilot is shifted about like a railway truck for the good of his soul. It is a nuisance—and, if he is married, a great deal more than a nuisance—to be moving about the place all the time. But only by organising a continuously mobile group of test pilots can any possible weaknesses in the present system be properly exorcised. I don't, for Heaven's sake, suggest that the moves need to be made more than once every six months, or that they need to be made without due notice, or that they should be haphazard.

Changes in the Team

It would probably be enough for the test pilots to be changed about between each of the many branches or subsidiaries of a firm, since it is obviously a good thing that the pilot who is experienced on a particular type (and who knows exactly where to look for and how to deal with the various snags inseparable from this type) should be allowed to stick to it—so long as he is not being wasted. And I consider that the really expert and experienced test pilot *is* being wasted if he is merely concerned with the routine testing of proved types which have been in production since the year dot.

When people use the generic term "testing" to describe the work, they are overlooking the whole crux of the matter. There is all the difference in the world between routine production testing and the work involved in the flying of an entirely new type. Needless to say, the same pilot can be equally proficient at either job, but each demands an entirely different set of values.

The prototype test pilot is starting from zero, and on his experience and honesty depends the whole future of the type, and possibly even of the war. It is terribly important that his opinions should be entirely unbiased and that he should not only be free of all "politico-domestic" influences, but also be in a position—nay, be compelled—to call in outside advice and opinion. He may be compared with a doctor who is called on to deal with an entirely new disease.

Needless to say, the details of the present-day prototype have been thoroughly thrashed out by all the people concerned before it even begins to look like a flying machine. All the equipment and the requirements have been previously organised, and the test pilot is not normally called upon to decide on its suitability for the purpose for which it was designed. But, knowing the purpose, he is expected to fly it and to arrange for any alterations which are necessary to improve it either as a flying aircraft or as a fighting machine. A new type may be the sweetest and most "performable," but it is no good if the pilot has a poor view, or if he is unable to get out easily in emergency, or if the control layout is tiring on long flights. *The prototype test pilot must have experience both of operational and of flying requirements.*

Routine testing, on the other hand, requires skill so that there is no wastage of material and effort in unnecessary crashes, and so that the pilot can cope precisely with any difficulties, such as the inevitable engine-failures or partial failures and the strange control reactions which may appear when things have not been put together quite as they should be. It requires experience of the type in question—and, better still, of a number of other types—so that the pilot can make intelligent suggestions to the flight shed people and so reduce the number of retests. Above all, it requires an honest and meticulous mind. But it does not require the degree of all-round experience and skill needed for prototype development.

"Passers-out"

The ordinary daily work of a production test pilot is that of a "passer-out" of aircraft, nothing more or less. It is no stooge job, and the pilot concerned probably has more fights than the halo-ed chap who is dealing, from time to time, with a prototype. After about three tests the production manager begins to get angry, and there may be a tendency to say, in effect, "Oh, hell. What's the good of bothering too much; the wretched thing will probably be a pack of useless rubbish within a week." And nothing in the world *is* so utterly stupid and useless as a wrecked aircraft. Well, rather than pass it out, the pilot may suggest that it is wheeled away and forgotten. Just one bad machine can cause the death or the capture of the world's finest fighting or bombing crew. So either it should be wheeled away and forgotten or made into a good aircraft at whatever cost in man and machine hours.

It is because aircraft do not, in spite of "mass production," turn out in exactly the same shapes that a routine test pilot is necessary at all. Not only are there differences in jigs, but the various parts are not all made in the same place, and, furthermore, people make mistakes. Any test pilot will tell you that each and every machine, as it is produced, feels and behaves unlike the last. There are even "bad" ones and "good" ones, with differences so slight and so mixed that the best pilot cannot always quite explain what it is all about. Service pilots, too, have their pets and otherwise. It is up to the routine test pilot to reduce the number of duds to an irreducible minimum—if necessary, by the most stringent and even expensive means.

Drastic Cures

That is where "independence" comes in. There are occasions when the only and obvious final cure for a particular trouble is to change, say, the ailerons, or even the wings, and to begin all over again. Nobody wants to do it; the change is expensive in time and material, and the firm's paid test pilot might be bullied into letting the thing go with, say, the maximum amount of droop, or cord, or other adjustment, to produce an averagely good result. And some poor operational pilot is given an aircraft

POINTERS TO PERFECTION

which is left wing low at low speeds and right wing low at high speeds. Maybe the test was carried out in bad weather and the right-wing-lowness was never discovered; or the test was of such short duration that a flaw, say, in in airscrew blade root never had a chance to develop sufficiently to give the chronic vibration which would lead to a discovery of the trouble while the aircraft was still on a non-operational flight—and not miles over the Continent.

Routine testing is of vital importance. Because, with the present rate of production, tests must necessarily be of comparatively short duration, they must be exceptionally stringent. No item or feature of which the test pilot feels the slightest doubt must be allowed to get by—whether it is a directional gyro which "topples" rather too easily, or the slightest irregularity in trim which would, in a type without a tab for that particular axis, become tiring over long periods. And if anybody doubts whether such points can be overlooked, I can produce, if necessary, quite a few examples from the personal experience of pilots of my acquaintance. Two such examples will do for the time being.

One of Those Things

In one, a blind-flying instrument had been installed with the storage dust-excluder still fitted; this restricted the suction and made the instrument only partially useful—it worked, but only just. Either the aircraft had been tested so carelessly that the obvious fault had not been noticed, or the instrument had been a replacement for one which was reported "dud" on test and the aircraft had not been taken into the air again after the change. In another case, the initial flight at a particular R.A.F. unit showed the machine to have a peculiar kind of fore-and-aft instability. It was afterwards found that not only had a job of work on the elevator been left incomplete, but the structure had been recovered with some of the rigger's tools still inside the horn balance! In fairness to all manufacturers, it must be admitted that this machine had already been to an R.A.F. unit. But it is a good example of the sort of thing that *can* happen.

If the Powers That Be ever have reason to believe that production testing is becoming sloppy, then the time has come either for the arrangement of a six-monthly reshuffle of test personnel or for the introduction of a group of "test pilots" who will appear without notice at the different factories and retest the day's output. I don't think that such visitations will ever be necessary at works where large aircraft are produced, since a great deal of work is involved in the testing of "giant bombers," and nothing is likely to get by, nor can such machines be tested in bad weather. The danger only applies in the case of smaller types which are being turned out in really large numbers; when a day or two's hold-up, due to fog or other cause, means that the test pilots are overworked, and that the less experienced or less ruthless of them is inclined to let things go.

The C. S. Complex

Knowing human nature, and, despite my remarks a few weeks ago, I cannot feel certain that either R.A.F. or "Civil Service" test pilots would necessarily be any better than those employed by a firm in which they naturally have an interest. The Civil Service has always had a "nine till twelve and two till five" complex, except when the "Servants" are of a naturally hard-working and enthusiastic disposition. Either a group of "test testers," or the movement of pilots from time to time, seems to provide the most obvious solutions of the problem—if there *is* any serious problem.

Undoubtedly the firms are now finding it difficult to find really good test pilots, and the solution is certainly not to be found in the posting of ex-operational pilots who are due for their period of rest. Testing, even production testing, is a job which requires enthusiasm and energy, as well as one for which only certain types of pilot ever really qualify with success. It isn't an easy job, nor is it by any means a rest-cure. The ex-operational pilot is either too tired to do it properly, or he is permanently bored and screaming to be posted back to a squadron. In general, the older pilot, who never expects or wants to go to war, but who will take a tremendous interest in work which he knows to be important, will make the best and most scrupulous test pilot.

As for the work of prototype testing, I am at least theoretically in favour of a mixed "pool" of pilots—though no doubt if I were the paid and happy servant of any particular firm I should want to wring my own neck even for suggesting such a thing. I cannot help feeling that a prototype is much too important merely to be left in the hands of one or two of a firm's pilots, however experienced and sensible and unbiased they may be. The "pool" might consist of a mixture of factory pilots, R.A.F. test pilots (who have had the benefit of experience with every type that has previously been produced), and operational pilots from the particular Command likely to be interested in the new type. Each of the two latter have a normal job of work to do, and would merely be seconded by name for the development work when this came along, while the first would naturally have his routine passing-out work to do, and would probably, in addition, make the preliminary flights in the prototype.

Should Have Been Strangers

The pool pilots, named and "at the ready" for such special assignments, would perhaps bring a greater degree of freedom and honesty into the criticisms than is at present possible. I can think of at least one type, produced in prototype form before the war, which would never have appeared in quantity at all if such a pool had been given a chance to go to work. And a lot of time, material and energy would have been saved for use on more worthy aircraft.

Well, there, for what they are worth, are my ideas. An occasional shuffle of routine test pilots, between firms or, at least, between the different branches of a firm, and a group of unbiased test checkers. Those for keeping up the standard of test work and ensuring the production of good and reliable aircraft once the sausage machine has been started. And a pool of pilots of mixed and wide experience from which a trio—one civilian, one Service test pilot, and one operational pilot—would be extracted when any prototype or flying scale model was ready for action. The civilian would be on the spot to watch the preliminary work, and the other two would be merely getting on with their normal flying until such a time as M.A.P. sends, through the Air Ministry or their own Command, a request for their presence, on attachment, at such-and-such a firm's airdrome. Once the prototype is under way, the whole job could then be left to the residents. "INDICATOR."

[On the Correspondence page (p. 421) will be found other views on the subject of test pilots.—ED.]

A.T.C. Enrolment Age Lowered

NOW that the organisation of the Air Training Corps has become fully formed and training capacity developed, the minimum age for enrolment has been lowered to 15¾ years. Uniforms will be issued to cadets of 15½ provided they have done three months' service in the Corps.

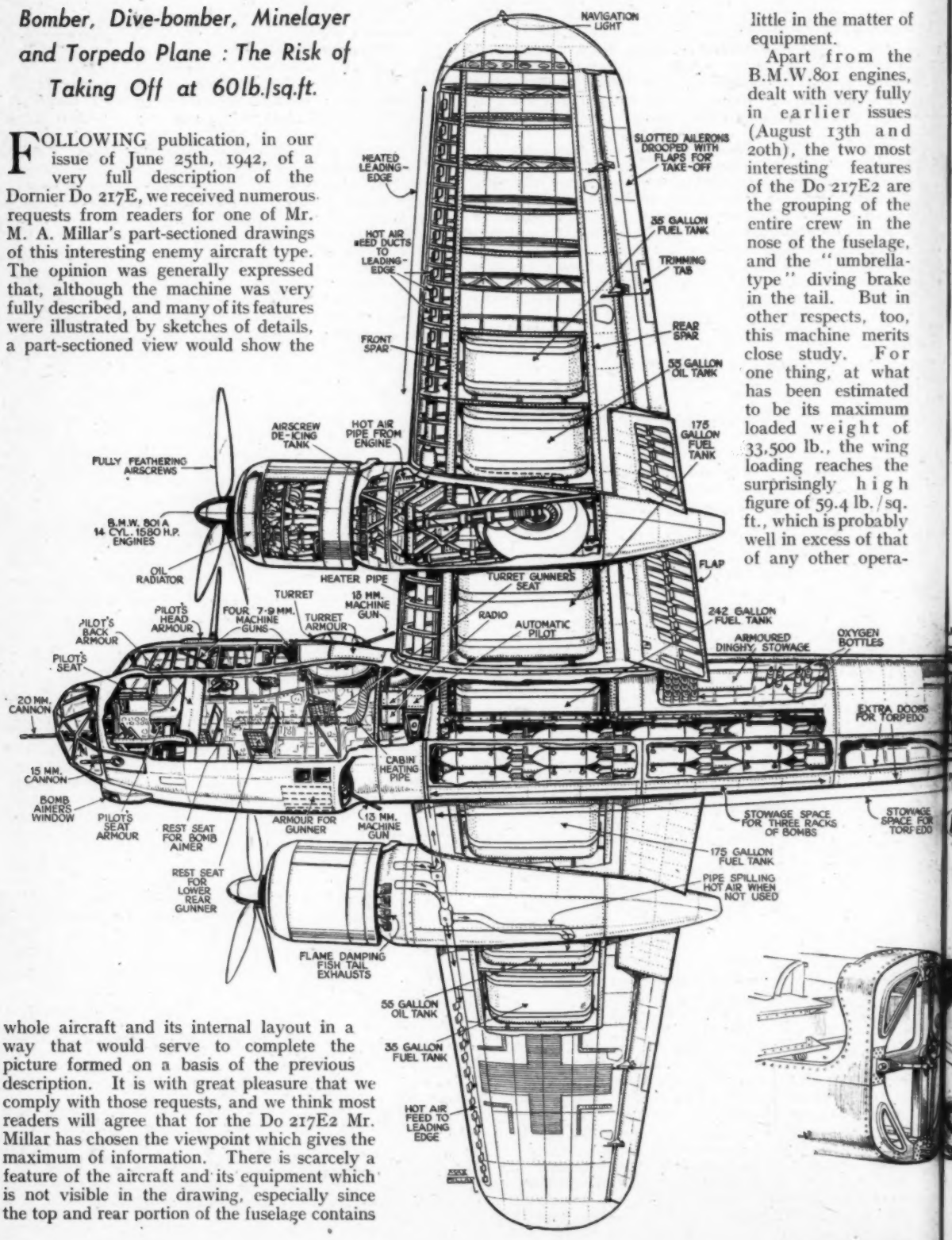
The previous enrolment age was 16, but cadets below 16 were allowed to participate in training where squadron facilities existed.

This new enrolment age of 15¾, intended primarily to help bridge the gap between school-leaving age and Corps service, was not previously possible without over-burdening the growing A.T.C. organisation. There was also the problem of providing uniforms for the very large number who wished to join the Corps. It was therefore decided first to concentrate on those higher age groups which would soon be reaching R.A.F. entry age.

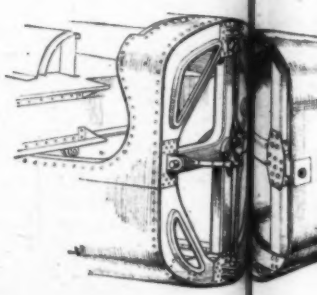
DORNIER Do 217E2

Bomber, Dive-bomber, Minelayer and Torpedo Plane : The Risk of Taking Off at 60 lb./sq.ft.

FOLLOWING publication, in our issue of June 25th, 1942, of a very full description of the Dornier Do 217E, we received numerous requests from readers for one of Mr. M. A. Millar's part-sectioned drawings of this interesting enemy aircraft type. The opinion was generally expressed that, although the machine was very fully described, and many of its features were illustrated by sketches of details, a part-sectioned view would show the whole aircraft and its internal layout in a way that would serve to complete the picture formed on a basis of the previous description. It is with great pleasure that we comply with those requests, and we think most readers will agree that for the Do 217E2 Mr. Millar has chosen the viewpoint which gives the maximum of information. There is scarcely a feature of the aircraft and its equipment which is not visible in the drawing, especially since the top and rear portion of the fuselage contains little in the matter of equipment.



Apart from the B.M.W.801 engines, dealt with very fully in earlier issues (August 13th and 20th), the two most interesting features of the Do 217E2 are the grouping of the entire crew in the nose of the fuselage, and the "umbrella-type" diving brake in the tail. But in other respects, too, this machine merits close study. For one thing, at what has been estimated to be its maximum loaded weight of 33,500 lb., the wing loading reaches the surprisingly high figure of 59.4 lb./sq. ft., which is probably well in excess of that of any other opera-



tional type. In view of the fact that the take-off run at that weight, with the engines developing a short-period take-off power of 1,580 b.h.p. each, is not far short of one mile, it is fairly obvious that when loaded to its limit the Do 217E2 needs some form of assisted take-off; a nose hook and a tail support on captured specimens appear to confirm this view.

Assisted Take-off

One does not envy the pilot—still less his crew—who has to be assisted into the air at a wing loading of 60 lb./sq. ft. and a power loading of nearly 11 lb./h.p. If his engines should fail shortly after leaving the ground (or even one of them falter a little), there will be little chance of saving the machine or the lives of the crew. It is true that there is provision for jettisoning the fuel, but in spite of the size of the jettison pipe, it would take some considerable time to unload sufficient fuel to make any appreciable difference. It seems more likely that in such an emergency the pilot would jettison his bombs. It is thought, from consideration of the bomb-stowage space available in the machine, that the maximum bomb load is in the neighbourhood of 6,600 lb., so that in the most favourable case (from this particular point of view) the pilot would be able to lighten the machine by that amount. That would reduce his wing loading to something like 44 lb./sq. ft., at which the landing speed would still be very high, probably not very far short of 100 m.p.h.

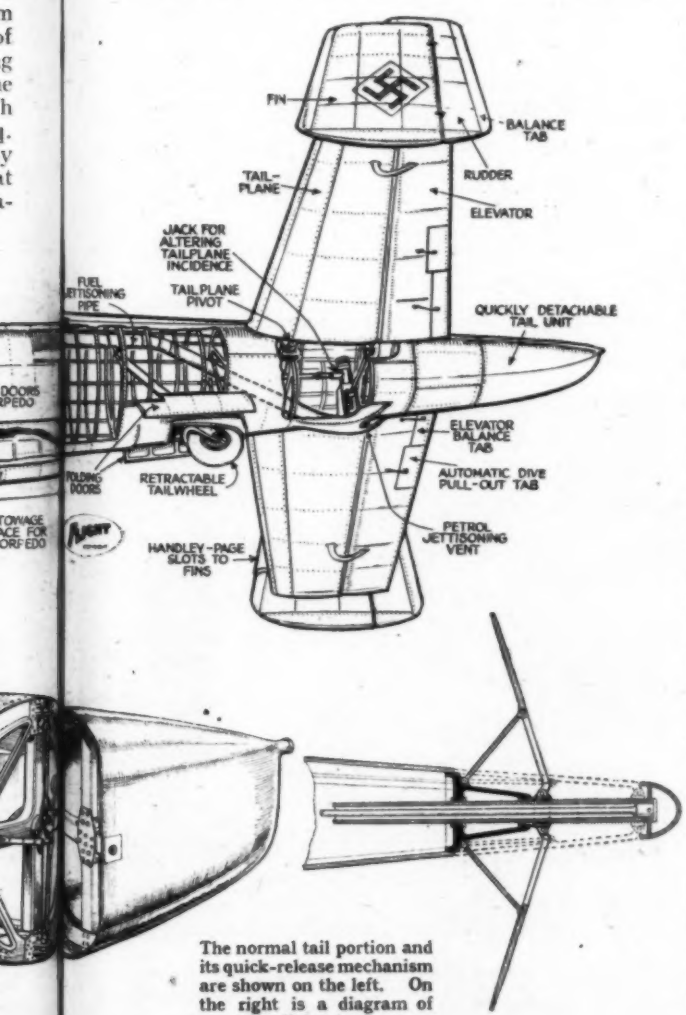
When wing loadings of this order are being used, there is something to be said for a system of assisted take-off which does not load the bomber to its full capacity until a height has been reached at which a substantial part of the load can be discharged, and from which the landing ground can be approached in the right direction and at the right height.

Incidentally, it is of interest to note that in the Do 217E2 the bomb load and the fuel-and-oil loads are approximately equal when both are at their maximum. It does not, of course, follow that both would ever be at their maximum in actual operations, although the maximum loaded weight of 33,500 lb. appears to be based on that assumption.

DORNIER DO 217E2

Two 1,460 b.h.p. B.M.W. 801 Engines

Wing span	62ft. 5in.
Wing chord (root)	12ft. 9in.
Wing chord (tip)	6ft. 9in.
Thickness/Chord ratio (root)	17 per cent.
Thickness/Chord ratio (tip)	8 per cent.
Aspect ratio	6.62 : 1
Wing area	610 sq. ft.
Maximum gross weight	33,500 lb.
Maximum speed	309 m.p.h.
Take-off run (full load)	1,550 yds.
Initial rate of climb (full load)	638ft./min.



The normal tail portion and its quick-release mechanism are shown on the left. On the right is a diagram of the diving brake.

Eight Guns

Defensive armament appears to vary somewhat according to the locality in which the Do 217E2 is employed, the duties it is undertaking, and the opposition it is expected to meet. That shown in the drawing may be taken to represent a maximum of armament, and not in all cases are all the guns fitted, although provision has been made for their mounting. The drawing shows a total of eight guns: Two cannon in the nose of the fuselage, two heavy machine guns (upper and lower) firing aft, and four light machine guns firing laterally.

The two cannon in the nose of the fuselage are operated by the pilot. When not actually engaged on bombing, the bomb-aimer works the two forward lateral machine guns. The dorsal gun is mounted in a turret, and the supports for the gunner's seat are in the form of arched tubes to give room below for the lower rear gunner, who must often have to work in a semi-prone position.

Normal offensive armament comprises an assortment of bombs which may vary from 50 kg. to 1,000 kg. in size. The machine may, however, be used for laying mines, and strong points for their support are provided. By taking into use the doors aft of the normal bomb doors, sufficient length is provided for taking a torpedo. Thus, the Do 217E2 is a versatile aircraft with several functions.

Aerodynamically and structurally, the Do 217E2 does not represent anything very novel, and, in fact—for an aircraft in which everything has been crowded together in order to achieve compactness and small size, and the wing loading pushed pretty well to the limit—the performance is not very spectacular at just over 300 m.p.h.

The one interesting feature of the design which is unusual is the drogue or diving brake. This has previously been described (*Flight* of July 2nd and August 20th), but we reproduce two sketches showing the release

DORNIER Do 217E2

mechanism for the normal fuselage stern portion, and a diagram of the diving brake. When the machine is not to be used for dive-bombing, the normal stern portion is fitted. There is a quick-release mechanism in the form of toggle bolts operated by a shaft and worm, and when the much longer tail cone housing the diving brake is fitted, this mechanism can be used for jettisoning the whole drogue unit.

The operation of the drogue is simple enough in principle: rotation of the threaded shaft causes the nut to travel along, and in so doing it tilts the "umbrella ribs" on which are mounted the four plates of the air brake.

It does not appear by any means certain that this form of diving brake is the best possible. The drag of it, being applied at the very extreme end of the fuselage, is a long way from the centre of gravity, and one imagines that as a result of this the pilot has little control over the angle of dive. Doubtless the area of the drogue blades has been carefully chosen to give the correct angle of dive, but circumstances must often arise in which a change of flight path would be desirable. A form of air brake placed nearer the centre of gravity would, therefore, appear preferable, since obviously the ideal air brake is that which offers the desired amount of drag while still leaving the pilot free to manœuvre.

SUNDERLAND ACCIDENT

Findings of R.A.F. Court of Enquiry

THE findings of the R.A.F. Court of Enquiry which investigated the accident to the Sunderland flying boat in which H.R.H. the Duke of Kent lost his life were made known by the Secretary of State for Air (Sir Archibald Sinclair) in the House of Commons

In reply to Sir R. Glyn, who asked if he was in a position to make a statement on the subject, Sir Archibald Sinclair said that the court found, first, that the accident occurred because the aircraft was flown on a track other than that indicated in the flight plan given to the pilot, and at too low an altitude to clear the rising ground on the track; secondly, that the responsibility for this serious mistake in airmanship lies with the captain of the aircraft. thirdly, that the weather encountered should have presented no difficulties to an experienced pilot; fourthly, that the examination of the propellers showed that the engines were under power when the aircraft struck the ground, and, fifthly, in accordance with K.R. & A.C.I., paragraph 1325, that all the occupants of the aircraft were on duty at the time of the accident. The Chief Inspector of Accidents is in agreement with the findings of the court.

Sir Archibald Sinclair explained that the sequence of events leading up to the accident were as follows:—

The aircraft, which was proceeding from a Royal Air Force Station in Scotland to Iceland, was airborne just after 1 o'clock in the afternoon of August 15th. Before departure, the correct procedure for briefing the captain as to the exact route to be followed and for providing full information about the weather conditions likely to be encountered, was complied with. Local weather conditions were not good at the time of the take-off but the general indications showed a likelihood of improvement to the westward. The captain of the aircraft was a flying-boat pilot of long experience on the particular type of aircraft which he was flying that day, and of exceptional ability. About half an hour after take-off the aircraft was heard approaching land from the sea at what appeared to be a low height, and shortly afterwards it was heard to crash into the hills

At the time of the accident the casualty list gave the name of the Sunderland's captain as Flt. Lt. Frank McKenzie Goyen.

Lord Trenchard in the Middle East

JUST as Lord Trenchard, Marshal of the Royal Air Force, stepped out of his aircraft at a Middle East airfield, word came through for the Squadron's four-engined Liberator bombers to strike at a Mediterranean convoy.

After greeting Air Commodore A. P. Ritchie, A.F.C., Air Officer Commanding the heavy bomber group, Air Commodore L. O. Brown, C.B.E., D.S.C., A.F.C., Air Officer Commanding Levant, and Group Captain F. M. Denny, commanding the heavy bomber wing, Lord Trenchard went immediately to the intelligence room to listen to the briefing.

He addressed the aircrews assembled there, telling them that the spirit of the air force surpassed even the pioneer spirit of the last war fliers which he once thought would never be equalled.

Lord Trenchard then went out on to the airfield to watch the take-off. The machines were airborne on the average one every 30 seconds.

Urgent War Freight by T.C.A.

TRANS-CANADA Air Lines is daily assisting the war effort of the United Nations. Not only is T.C.A. geared to the war effort in the transportation of personnel of the Armed Forces and of the Government, but also in the speedy handling of war materials. Just as transportation of personnel means connections with air lines of other nations, so does the handling of freight mean the linking up with United States and South American air lines.

Recently a request was received for T.C.A. to handle a 235-pound crankshaft which was urgently required for an oil tanker docked in an Atlantic port. The firm selected for the job is located in the Maritime Provinces of Canada. The shaft was completed, put aboard the T.C.A. aircraft at Halifax, and just 72 hours later it was being installed in the tanker.

Another instance was in the shipment from a Canadian plant of a 450-pound part needed for a torpedoed ship laid up in a South American harbour T.C.A. got in touch with connecting air lines in the United States and South America, and in an unbelievably short time the ship was repaired and back on active service for the Allies.

Fitting a collapsible dinghy into a bomb container on the stub wings of an Air/Sea Rescue Lysander. The ballistics of a folded dinghy must be difficult to assess.

HERE AND THERE

Inter-island Air Service

A REGULAR passenger airline service has recently been opened between two Portuguese islands in the Azores, namely, San Miguel and Terecira.

Airgraphs by the Million

THE G.P.O. states that over 45,000,000 airgraph letters have been sent since the service was introduced about 16 months ago, and the weekly average is now 1,000,000 letters in each direction.

Entry of Aircraft Apprentices

SCHOOLS and other nominating authorities are reminded that the latest date for the receipt at the Air Ministry of nominations for the November examinations for aircraft apprentices in the R.A.F. is October 27th.

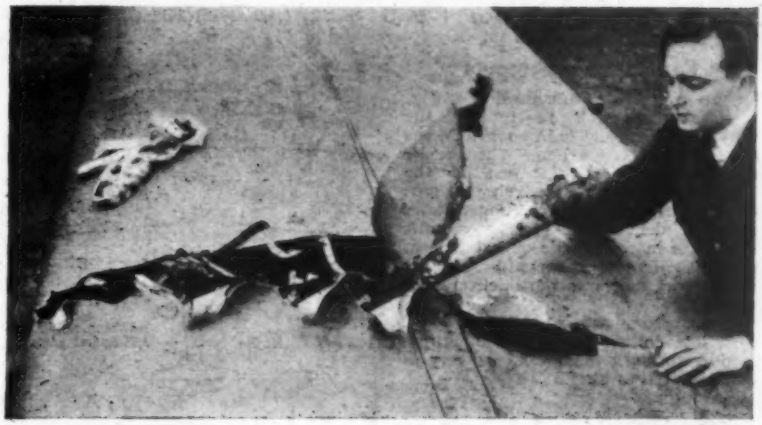
Prize R.A.F. Gardens

THE winner of this year's Royal Air Force Unit Gardens Competition is a bomber station in Lincolnshire. After inspectors of the Ministry of Agriculture had reduced the field to the last eight, Dr. H. V. Taylor, Horticultural Commissioner, Ministry of Agriculture, made the final selection.

Aircraft for the U.S. Navy

MORE than twice the number of aircraft were supplied to the U.S. Navy during the fiscal year ending on June 30th compared with the previous 12 months, according to Carl Vinson, chairman of the House of Representatives Naval Affairs Committee. The total for the past year was 4,895 as against 2,067 for the year before.

An output of close on 2,000 Navy aircraft per month was being rapidly approached, he added, as the result of factory expansions.



POLE OR PERCH. During a low-level attack over Northern France this Boston wing struck the top of a steel mast and "collected" four feet of it. Despite the obvious damage the Boston flew home quite normally apart from a slight drop in speed.

Blue Air Mail Labels

THE Postmaster-General wishes to remind the public that a blue air mail label, obtainable free of charge at any post office, should be affixed to the top left-hand corner of the address side of all letters and postcards intended for transmission by air mail. Alternatively, the indication "By Air Mail" may be written prominently in the same position, but the absence of an air mail label may lead to delay.

Television System for Fog Flying

INVISIBLE infra-red rays converted instantly into visible images on a screen on the instrument board are employed for enabling pilots to see through fog and haze by means of a system invented and recently patented (U.S. No. 2,288,871) by Harold A. Adams, of Bakersfield, California.

The system, as described, consists of a camera which may be located wherever convenient in the fuselage and turned in any desired direction, a television transmitter that scans the image on the camera screen and sends the varying electric current by wire to a television receiver on the instrument panel, where it is converted instantly and continously into a visible picture.

Infra-red rays reflected from objects can penetrate fog and moisture or smoke haze that stop visible light rays. Movement as well as stationary objects can be seen on the screen of the receiver.

The system seems to offer a possible solution of the blind-flying and landing problem.

Day and Night Offensive

MAJ. GEN. IRA C. EAKER, commanding Eighth Bomber Command, U.S. Army Air Forces, is reported in a *Daily Mail* interview to have expressed the opinion that there are enough airfields, built and under construction, in Great Britain to accommodate all the Allied air forces needed for the destruction of Germany by means of a day and night offensive which will give the enemy defences no rest.

"There is nothing that can be destroyed by gunfire that cannot be destroyed by bombs," he said, adding that he believed the enemy could be destroyed from the air and that within the next few months every opportunity for hitting the enemy in depth and strength would be demonstrated by U.S. bombers.

Night operations by the R.A.F. and day operations by Americans would not only mean a non-stop day-and-night onslaught, but would avoid congestion in the air and on airfields.

And Incidentally—

AN air mechanic, reporting for duty at a boat station of the R.A.F. Air/Sea Rescue Service, was asked by the flight-sergeant if he was a coxswain.

"No," was the answer, "a South African."

PROMPT REPLACEMENT. The new U.S. aircraft carrier *Lexington* slides down the slipway one year ahead of its building schedule, to replace the one sunk in the Coral Sea battle.

BEHIND THE LINES

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

For Japan's Puppets

IN an agreement concluded recently, Japan undertook to provide the Nanking government with aircraft to the value of 300,000,000 Yen. The aircraft are to form the equipment of the "Nanking Air Force" which the Japs are now setting up in their Puppet State. The first delivery of training aircraft took place in the middle of last month, and on the first of this month a number of transport machines were delivered at Nanking.

A Japanese report states that a special ceremony is scheduled at Nanking during October to mark the formal delivery of a third batch of aircraft.

"Luftwaffe" Satellites

RUMANIAN Air Force units, whom their Government so obligingly placed at the disposal of the *Luftwaffe*, have suffered serious defeats from the Russian Air Force. To keep up with their losses it is now reported that under the guidance of the German air mission young men between 18 and 22 who have completed four years at a secondary school will now receive flying training.

Spain is more economical with supplying cannon fodder for the Nazis. The merely symbolic Spanish air unit on the Russian front has been strengthened by a batch of forty Spanish airmen who, a few days ago, left Seville for Germany.

They will serve with the so-called Spanish Volunteer Flying Corps at the Russian front.

Less Bauxite

FOR many years the German aircraft industry has been relying to a considerable extent for their supplies of aluminium on the bauxite deposits in the Balkans.

The Italian newspaper *Il Sole* reports now that the production of bauxite in Dalmatia has dropped considerably during this year. While Dalmatia supplied 270,000 tons of bauxite during the first half of 1941, the figure for the corresponding period in the current year is only 107,000 tons.

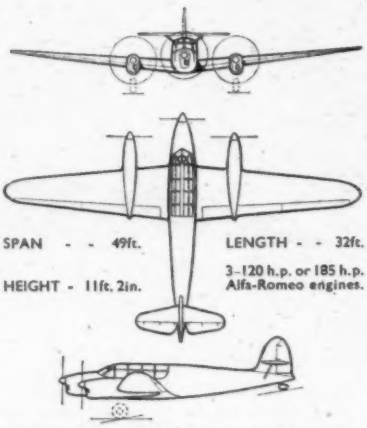
Although other sources of this vital material are available for the Axis industries, this decline at a time when all German resources are being strained to increase the production of aircraft is undoubtedly a serious set-back.

It is significant that the Italian report attributes this decline to the ever-increasing transport difficulties.

Less Engines

THE works of the Societe Nationale de Construction de Moteurs S.A. (formerly Lorraine), of Argenteuil, near Paris, have suspended production. While it is not certain whether they will reopen again, the official statement says that the works are closed down for only a few months.

It will be remembered that the plant was engaged in the production of German BMW 801 engines and has probably been seriously damaged in the R.A.F. raids.



A general arrangement drawing of the three-engined Cant Z.1012 which is described on this page.

Cant Z.1012

A RECENT Italian development in the light aircraft class is the training and civil type, the Cant Z.1012. This is a low-wing cabin monoplane with a retractable undercarriage, seating accommodation for four, and powered with three four-cylinder or inverted six-cylinder air-cooled engines.

The fuselage is of an almost elliptical section and of excellent streamline shape. It is made of wood with the principal longitudinal structure consisting of a strong keel-bottom with a stout longeron above and two side stringers. Ribs help to stiffen the skin and take the stresses. The front part of the fuselage is closed by a partition with the necessary attachments for the engine mounting.

Wing structure is entirely of wood, covered with plywood or other composite material (plastics?). The wing root section contains four fuel tanks, two in the left and two in the right. In the next section (towards the wing tip) are the housings for the retractable undercarriage, which fits in between the two spars.

The two engines are mounted on solid supports of welded steel tubing, and the nacelles help partly to house the undercarriage wheel. The wing has two large ailerons extending along the greater part of the span.

Tail unit is of wood, covered with a composite material; the tailplane being an integral part of the fuselage.

Side-by-side seating is arranged for instructor and pupil. The normal total seating capacity of four can be increased to six by reducing the amount of fuel carried.

The power plant of the Cant Z.1012 is composed either of three Alfa-Romeo 110 four-cylinder air-cooled engines of 120 h.p. each, or of three Alfa-Romeo 115 inverted six-cylinder air-cooled engines of 185 h.p. each.

The following are the dimensions and performance details of the Cant Z.1012 powered with Alfa-Romeo 110 engines (figures for the version equipped with Alfa-Romeo 115 are stated in brackets): Span, 49ft.; length, 32ft.; height, 11ft. 2in. Total weight, 5,900 lb. (6,800 lb.); disposable load, 1,760 lb.; power loading, 16 lb./h.p. (12 lb./h.p.); wing loading, 22 lb./sq. ft. (24.5 lb./sq. ft.); speed: min. 61.5 m.p.h. (64.6 m.p.h.); cruising at 1,900 r.p.m., 150 m.p.h. (166 m.p.h.); max. 190 m.p.h. (220 m.p.h.); Power developed at 2,200 r.p.m., 360 h.p. (555 h.p.); climb to 6,000ft. in 14 min. (10 min.); range: 800 miles (600 miles).

Nazi Reactions

ARTICLES in the Nazi press, broadcasts and speeches reveal that the German mind is confused with the violence of the R.A.F. raids. Educated to believe that no one else could do it, the Germans now face the reality. There is, therefore, literally a flood of verbose attempts to boost the morale by pointing out the excellence of A.A. defences.

A leading Munich paper, dealing in a long article with the R.A.F. raid on that city, says that it is due to the concentrated defences that only a part of the raiding aircraft managed to drop their bombs on the centre of the city. "If fifty English airmen had had the opportunity to exhaust their fury on the town," says the paper, "extremely severe damage would have been suffered." But, despite such consolation, the writer of the article admits that R.A.F. raids begin to tell on German nerves, and finds it "incomprehensible that some citizens show their gratitude by walking about criticising and grumbling."

A frank appreciation of the R.A.F. raids can be found in the two-hour speech delivered by Goering on October 4th. The chief of the *Luftwaffe* said: "I am far from treating these attacks as mere trifles. I know how heavy they are—I am an expert . . . I make every attempt humanly possible to prevent such air raids, and to ease the situation. First, there is the question of active defence. But no one must forget that I must at the time concentrate most in the East, and that I am unable to provide the defence which will be given one day. . . . Night fighters which to-day are only available over a certain part of the Reich will be extended all over Germany, and then we shall talk again."

Meanwhile, Goering attempts to pacify the growing uneasiness of the public and assures them that more and greater stores will be continually accumulated from which the air-raid victims will be immediately supplied.

But this is not enough. Where is the *Luftwaffe?* Why doesn't it stop the R.A.F.?—ask the Germans. And Hermann Goering replies: "How terrible all that is for me, and sometimes I can hardly . . . well, in plain language, I am beside myself because I cannot immediately deal a reprisal blow. . . To-day the *Luftwaffe* is fighting in a way you cannot imagine, day after day, at Stalingrad and wherever decisive victories are at stake. When it has finished there, we will meet again at Phillipi."

So Simple

No special qualifications are required to operate the E.C.D. mobile water purification plant, an unskilled person can be placed in charge of it after brief and easy instruction. The apparatus is practically foolproof and is essentially reliable. From one to 3,000 gallons per hour of pure, tasteless and odourless water from contaminated supplies can be delivered for long periods, even under very difficult conditions.

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MOBILE WATER PURIFICATION PLANT

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Eighteenth of the New Recognition Series

AIRCRAFT TYPES AND E

GRUMMAN AVENGER

NEXT to the controversy about dive-bombers, Britain's fighting equipment in the way of torpedo aircraft has lately been exercising thought and comment in and out of the Services—and Parliament. Nobody can deny that a biplane carrying one 18in. torpedo is inadequate to-day, yet that is the obsolete type upon which the Fleet Air Arm has so far had to depend.

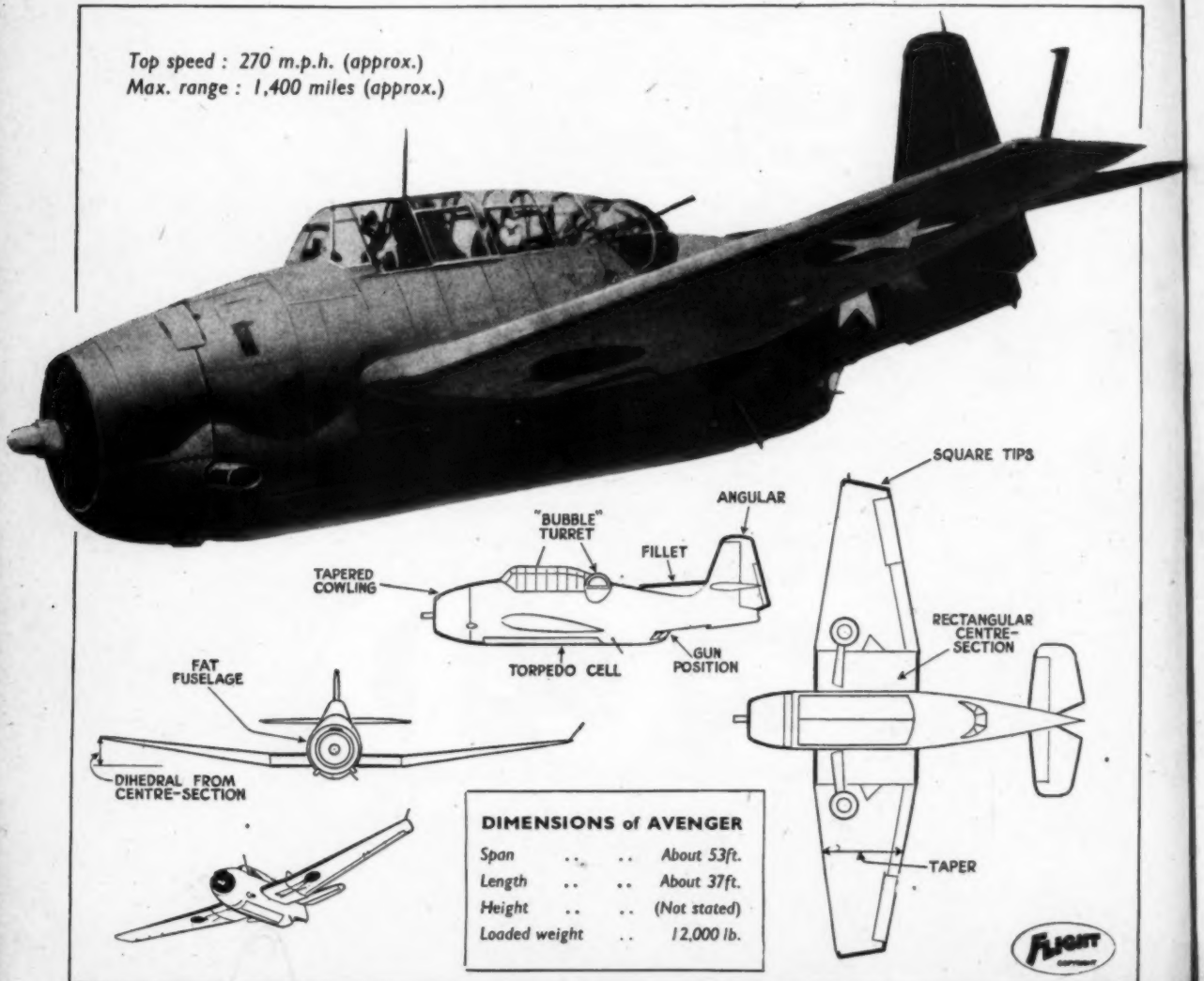
America, on the other hand, now possesses in the Grumman Avenger something really useful in the shape of torpedo-bombers, and, while there is no official information on the subject at the moment, it seems well within the bounds of possibility that this type may appear in due course with British markings.

The Avenger, now in quantity production and already in service with the U.S. Navy, has already done quite a bit of avenging in the Pacific, particularly in the Midway action, and is credited with being the fastest and deadliest carrier-borne torpedo-bomber yet produced. Others, equally deadly, may well be on the way, of course.

An unusually big machine for operating from an aircraft carrier, it carries a 21in. torpedo within the belly of the fuselage, or alternatively, it can stow away some 2,000 lb. in bombs, according to requirements. Its defensive armament would appear to be fairly good, for in addition to guns in the nose and at the rear of the torpedo compartment, it carries a "bubble" gun-turret amidships, at the back of the long, raised "glasshouse." From photographs which have reached this country it appears that this turret mounts two machine-guns; the under gun is manually operated from a prone position. The exact nature of the forward firing armament has not yet been stated, but it probably comprises two synchronised fixed machine-guns firing from troughs and operated by the pilot in the usual way.

The Avenger is powered by a 1,600 h.p. Wright Double-row Cyclone, and is said to be capable of some 270 m.p.h. at about 7,500ft. Its cruising speed is believed to be approximately 215 m.p.h., and its service ceiling in excess of 20,000ft. Maximum range at operating speed is in the region of 1,400 miles.

Top speed : 270 m.p.h. (approx.)
Max. range : 1,400 miles (approx.)

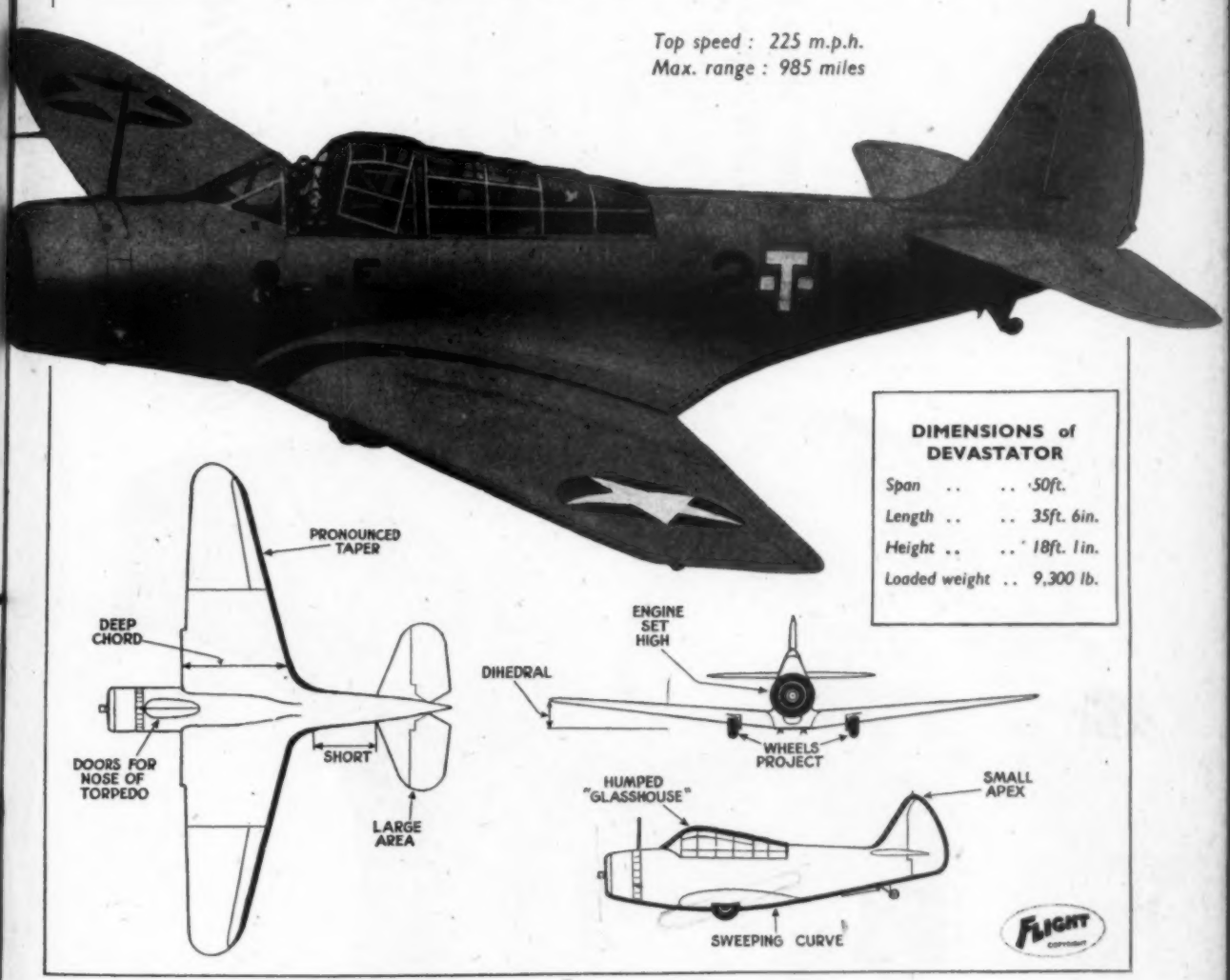


DIMENSIONS of AVENGER

Span	.. ..	*About 53ft.*
Length	.. ..	*About 37ft.*
Height	.. ..	*(Not stated)*
Loaded weight	..	*12,000 lb.*

EIR CHARACTERISTICS

DOUGLAS DEVASTATOR



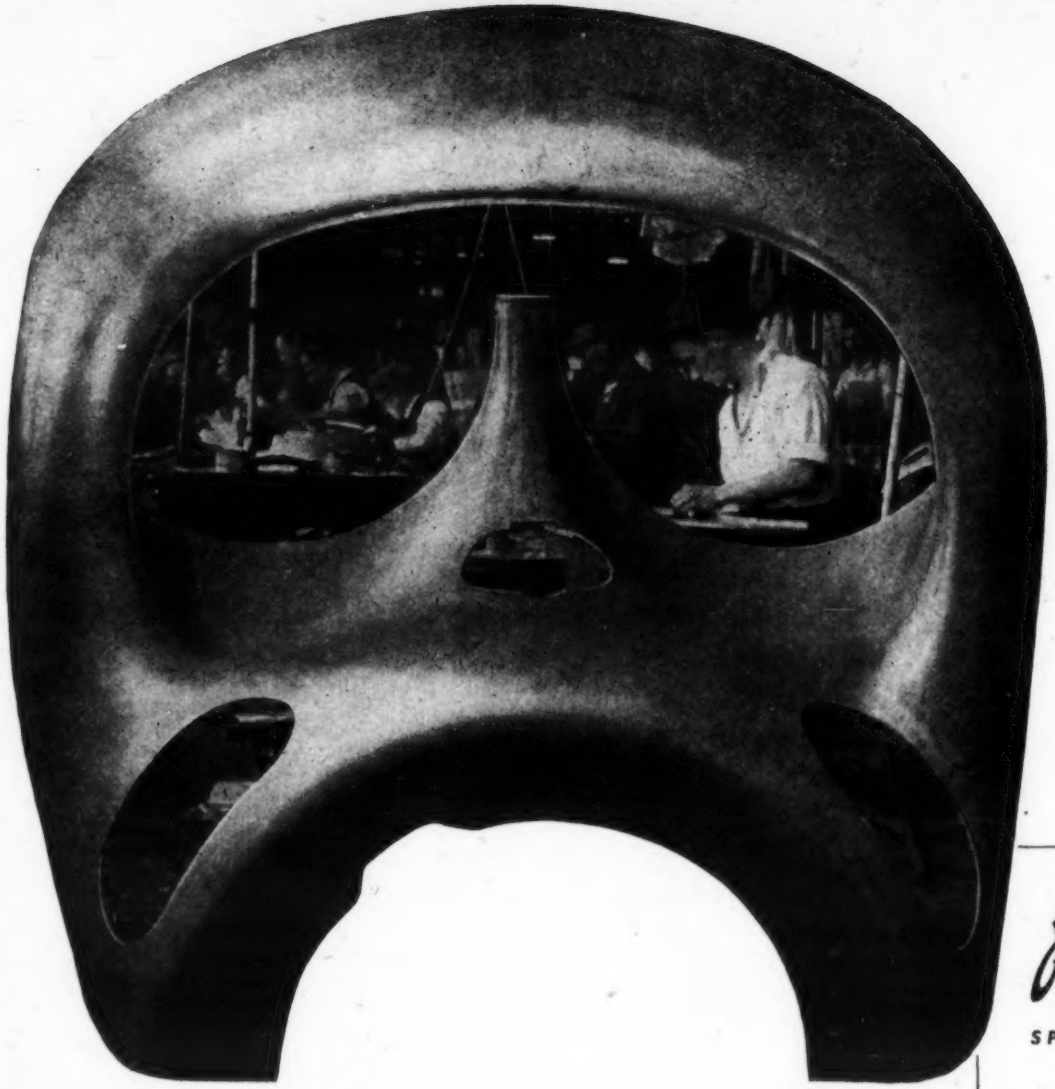
A SOMEWHAT smaller (and much earlier) type of torpedo-bomber in service with the U.S. Navy, the Douglas Devastator, first found its way on to their aircraft carriers as long ago as 1938. Its type designation is TBD-1, and it was standard equipment on the *Saratoga*, *Yorktown*, *Enterprise* and *Hornet*. Though now outclassed by later types, such as the Avenger, the Vultee TBV-1, and the Vought-Sikorsky TBU-1, the Devastator has seen action during the present war, and is still one of the U.S. Navy's standard torpedo-bombers.

The Devastator was probably the world's first *monoplane* torpedo-bomber when it made its initial appearance in 1937. But even so, it owed something to British pioneer work in torpedo-carrying aircraft during and after the last war, for in the early 1920's a Blackburn Dart torpedo-plane was taken to America, and there is no doubt whatever that this old biplane exercised its influence on the Douglas BT-1 of 1923, of which the Devastator is a lineal descendant. Although it is one of the less well-known types of American aircraft, so far as we in this country are concerned, the TBD-1 has done some useful work since that fateful December 7th at Pearl Harbour, and gained honourable mention in the American victory off Midway Island.

The Devastator carries its 21in. torpedo in a cell or recess under the fuselage, but with its nose projecting; it is therefore housed semi-internally, and the alternative of a bomb load is provided for—particularly the large armour-piercing bomb. A distinctive structural feature is that the skin of the wings (it is of all-metal construction) is corrugated outboard of the rearwardly retracting undercarriage; the wings fold upwards for carrier stowage about half-way along the semi-span. Defensive armament is limited to one fixed synchronised 0.300in. machine-gun mounted above the cowling, and one manually operated "free" 0.500in. gun in the rear cockpit.

Judged by modern standards, its performance is only moderate, its 825 h.p. Pratt and Whitney Twin Wasp Junior engine giving it a top speed of 225 m.p.h. at 9,000ft., while its range is 985 miles at an operational speed of 180 m.p.h. A crew of three is carried—pilot (who releases the torpedo or bombs), radio operator-navigator and rear gunner.

The "kinks" shown in the leading-edge are not sufficiently pronounced to assist the spotter in recognition.



. . . no, this queer shape is no relic of some prehistoric age, but a front engine nacelle fairing, in the course of construction. On the face of it, it may appear to be a difficult shape to create from a sheet of aluminium alloy—but not so when that metal is in the hands of Ranalah craftsmen. These specialists can do the most complicated things with sheets and tubes of aluminium alloy, working to such close limits that interchangeability of parts is guaranteed.

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AIRCRAFT PROPULSION SYSTEMS

An Examination of the Possibilities of the Combustion Gas Turbine : Turbines in Conjunction with Airscrews

By G. GEOFFREY SMITH, M.B.E.

THE accompanying article is complementary to the series on jet propulsion, and it will be seen that there are similarities in the basic principles : turbines and compressors are common features. The articles on jet propulsion appeared in the following issues : 1941 : Aug. 28th, Sept. 11th, Sept. 25th, Oct. 9th and Dec. 4th. 1942 : Feb. 9th and April 30th.

PREVIOUS articles in this series of discussions of propulsion projects have suggested that we may be on the threshold of a new era of power generation by gas turbines. The writer confesses to considerable enthusiasm for the gas turbine, and is of opinion that it may, in course of time, seriously rival reciprocating engines for the propulsion of aircraft. For one thing, the Otto cycle type of engine involves three idle strokes for every power stroke, and waste of effort occurs in any form of reciprocating movement which is transformed into rotary motion by the aid of a crank and piston rod. To-day the four-stroke cycle engine is favoured as a consequence of its advanced stage of development. Such enormous amounts of time, energy and money have been lavished on research, experiment and testing of this type that at present it is the most advantageous proposition. Principles of design, construction and operation are well established, and the weight, performance and reliability of any new unit can be closely predicted.

Alternative Systems

One of the most attractive propelling agents for aircraft upon which scientists of many countries are at work is the gas turbine. Such a prime mover is even more simple in design than the steam turbine, more readily adaptable to aircraft use, and being compact is conveniently accommodated in a perfectly streamlined structure. Development proceeds with gas turbines and axial air compressors in conjunction with airscrews; using the exhaust jet reaction as a method of propulsion ; or a combination of the two systems.

Lest it be imagined that the gas turbine is a quite recent innovation, it may be of interest to recall that the first experimental efforts with this type of power plant date back to the Stolze hot air turbine of 1872. In 1906 Brown-Boveri, a Swiss firm, designed and built the first multi-stage centrifugal compressor for a gas turbine built by Lemale and Armangaud in Paris. Progress was slow owing to the poor heat resistance of available steels and the low efficiency of air compressors.

The ultimate criterion of any heat engine is the thermal efficiency, that is, the *heat value* of the power delivered at the engine shaft coupling expressed as a percentage of the *heat value* of the fuel consumed. Let us consider a simple hypothetical instance. Using approximate figures, aviation spirit has a calorific value of 20,000 B.Th.U. (British thermal units) per lb. and a specific gravity of 0.7. One gallon of fuel will thus weigh about 7 lb. and have a calorific value of 140,000 B.Th.U. The mechanical equivalent of 1 B.Th.U. is 778ft.-lb. (foot-pounds), whilst 1 h.p. is the expenditure of 33,000ft.-lb. in 1 min. It follows that 42.4 B.Th.U. are the heat equivalent of 1 h.p. for 1 min. and 2,545 B.Th.U. equal 1 h.p. for one hour, which is the usual designation.

Now, if we run an engine continuously for one hour by consuming one gallon of fuel, we have supplied 140,000 B.Th.U., the heat equivalent of 55 h.p. If the engine actually develops 17 h.p. the overall thermal efficiency would give a figure of 31 per cent.

Where has the difference of 38 h.p., reduced to its basic equivalent of 96,710 B.Th.U., been expended? The accompanying diagram, Fig. 1, shows the thermal losses on a typical four-stroke petrol engine. This dissipation of energy is inherent in the combustion system. With better fuels and constructional materials and by ingenious design, some improvement may be expected, but it will be mainly confined to the less important items. The loss of 55-60 per cent. of heat by way of the exhaust and the cooling system will remain.

A new cycle of operations, the Diesel compression ignition system, enabled a full charge of air to be drawn into the cylinder and a higher compression ratio to be employed. The "expansion ratio" was improved, the engine ran with a cooler exhaust, and thermal efficiency was raised by approximately 5 per cent. Petrol companies then developed 90 octane and anon the 100 octane fuel, which enables higher compression ratios to be used on "explosion" engines without undue risk of detonation, and thus brought the petrol engine to approximately the level of the diesel unit.

Features of Reciprocating Engines

In both cases, however, handicaps are imposed on future development. Being reciprocating units, speeds must be limited owing to the rubbing contact of metal on metal (piston in cylinder) and, for the same reason, temperatures must be kept down. As the piston must be decelerated, the motion reversed, and then accelerated at each end of its stroke, enormous loads are imposed on connecting rods, crankshafts and bearings. Valve operation to ensure adequate filling of the cylinder at high speeds is a major problem. Furthermore, only one stroke of the four (induction, compression, firing, exhaust) is directly used to deliver power to the shaft. The two-stroke engine with one working stroke in two offered a slight advantage in this respect and greater simplicity, but introduced other difficulties, not the least being increased consumption.

Despite the importance and interest of thermal efficiency, many other factors must be taken into consideration when choosing the type of engine for specific duties under particular conditions. Assuming reliable performance and a reasonable rate of fuel consumption, weight and bulk are of special importance in aircraft installations. If a new and thermally more effi-

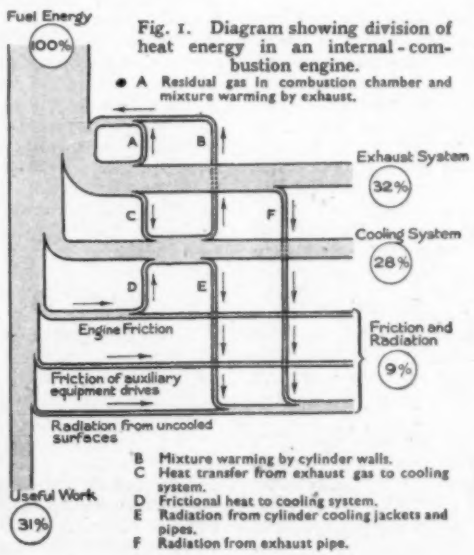

Fig. 1. Diagram showing division of heat energy in an internal-combustion engine.

AIRCRAFT PROPULSION SYSTEMS

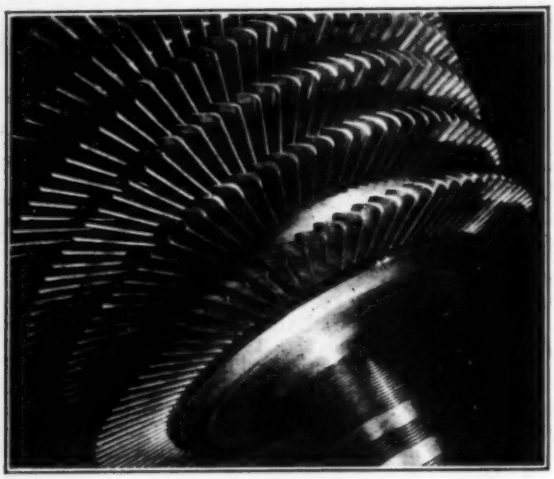

Fig. 2. Turbine rotor, showing profile of blading.

cient engine were substantially heavier or occupied more space per b.h.p. than our present units, it would inevitably be of little or no interest to aircraft designers. That is why the potentially more efficient diesel engine does not seriously rival the four-stroke petrol engine at present, though considerations of long-distance flight on civil and freight-carrying aircraft may yet bring it forward. The highly developed aircraft petrol engine has been reduced in weight from 4.3 lb. per b.h.p. in 1920 to 1.4 lb. per b.h.p. in 1937. To-day, mainly due to supercharger improvements, improved metals, fuels and greater knowledge of combustion, the larger units scale only a fraction over 1.0 lb. per b.h.p.

Growth of Engine Sizes

In time of war, development is likely to be tremendously accelerated. The pre-war "big" engine of 1,000 h.p. has already become a "medium-power" engine, and units of more than 2,000 h.p. are now not uncommon. These larger units have up to 24 cylinders, 96 valves and 2 crankshafts, and would seem to mark what is a practical limit to the size of a single reciprocating unit, pending further developments with airscrews.

Reasonable estimates of requirements in the not too distant future suggest that engines of 3,000/3,500 h.p. will be demanded by aircraft designers. Multi-bank radial, "X," flat and H-type units in this class are, in fact, being seriously investigated by the engine-building concerns in several countries. For an output of this order or over it is conceivable that it may be desirable to operate two or more standardised engines in conjunction. Any substantial increase of the diameter of individual cylinders would involve structural and cooling difficulties. Similarly, an increase in the length of the piston stroke would raise inertia loads and, unless the rotational speed were reduced, would result in unfavourable piston speeds. Either would lead to an undesirable increase in the specific weight per h.p., thus rendering the engine less attractive for aircraft installation. For more powerful engines the tendency is to employ a larger number of cylinders, thus double-row radials are now affecting eighteen cylinders instead of fourteen, and multi-bank engines are on the drawing boards.

This multiplicity of cylinders means that the total energy is applied to the driving shaft in a series of small impulses occurring in rapid succession. A six-cylinder engine has three power impulses per revolution or, in other terms, the firing interval is 120 deg. of crankshaft rotation. On a twenty-four cylinder unit of the same capacity, the firing interval would be 30 deg. of crankshaft rotation, and there would thus be twelve smaller power impulses per revolution. When this feature is considered, it is obvious that the running gear (pistons, connecting rods and crankshaft) and also the general engine structure (cylinders, heads and crankcase) can be of relatively light construction. Conversely, imagine what the result would be if, instead of using twenty-four cylinders as on the Napier "Sabre," we built a six-cylinder engine to give the same output of about 2,400 h.p. Not only would the weight and space be increased, but the aircraft structure would probably have to be redesigned and strengthened to accommodate it with safety.

Rotary Motion the Aim

It will be seen that the greater the number of cylinders employed the nearer is the approach to a *continuous* application of energy. Of course, the number of cylinders cannot be increased indefinitely; the cost, the complication and the number of component parts assume staggering proportions. Logically, however, continuous instead of intermittent power is the aim. When multiplying the number of cylinders ceases to offer practical advantage, an improved operating method must be sought.

This aim is not novel, but whilst existing types of engines could fulfil all requirements it remained largely academic

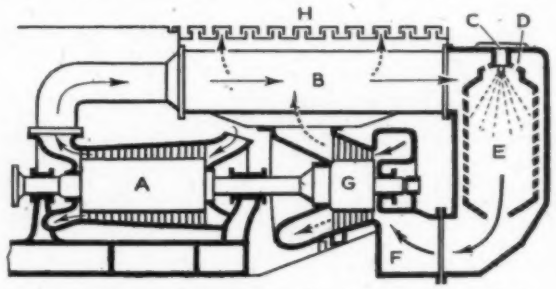

Fig. 3. Diagrammatic section of 2,000 h.p. unit for Swiss Federal Railway locomotive.

A Axial-type rotary air compressor. B Air preheater.
C Fuel injection nozzle. D Air admission ring.
E Combustion chamber. F Mixing chamber.
G Axial Flow combustion gas turbine. H Exhaust outlets to atmosphere.

in character. To-day it has become a practical necessity and researches and experiments are being vigorously conducted. The next step is from the reciprocating engine to the turbine which, due to the purely rotary motion and the absence of rubbing contact of the working parts, would enable power to be generated continuously at high rotational speeds. Only by such means, it would appear, can huge power outputs be obtained from relatively light and compact power units suitable for the needs of future aircraft.

In this connection it is of more than passing interest to recall the evolution of steam power. For more than a century the reciprocating steam engine virtually performed the work of the world. The demand for higher power output in smaller space for marine propulsion was the practical need which led Sir Charles Parsons to develop the steam turbine.

In spite of deep-rooted prejudice and determined opposition from the advocates of the then existing reciprocating engines, the value of the turbine was proved and it was soon unrivalled on land and sea wherever huge power outputs were required.

Allied Problems

Two avenues of development confront aircraft research engineers, and curiously they are allied in principle though entirely different in their objects. I refer to the exhaust turbo-supercharger as applied to reciprocating engines and

the turbine-compressor combination for use with jet propulsion, many projects of various countries having already been discussed in this series of articles.

So far as these major components, the rotary compressor and the gas turbine, are concerned, when used for propulsion they are, of course, much larger and more complicated. But with an already complicated multi-cylinder petrol engine, the necessary supercharging arrangements, either gear or exhaust driven, add further complication. It is readily apparent, therefore, comparing a turbine-compressor unit with a complete normal type four-stroke engine, that cost, complication, man-hours in production and particularly weight can, or should, be very materially reduced in the case of turbine plant. Considered from the viewpoint of power generation, these claims are important. But schemes employing gas turbines for motive power in combination with normal type airscrews are the main burden of these notes, and examples are illustrated and referred to later.

Research on units for aircraft propulsion is divided between steam and gas turbines. A review of steam turbine projects appeared in these columns on April 30th and July 30th last. For example, the Great Lakes Aircraft Corporation of America has produced a design of a propelling unit developing 2,300 h.p., in which the turbine is said to rotate at 20,000 r.p.m., and is actuated by steam at 70 kg./sq. cm. and 535 deg. C. The unit weighs 1.6 kg./h.p. More recent developments should enable that creditable power/weight figure to be improved upon. At the moment the cooling condenser remains the heaviest part of a steam-propelled unit, and attention is now being given to the possibility of utilising the surface of the wings for cooling, and at the same time provide a simple solution of the problem of de-icing.

Constant Volume or Constant Pressure

Research on the combustion gas turbine has followed two schools of thought. One advocates combustion of fuel on the "constant volume" cycle and the other on the "constant pressure" cycle. In the first, for instance, the Holzwarth turbine, the combustion of fuel and air occurs in closed chambers, each of a "constant volume," and the resultant gases are released through valves and nozzles to impinge on the blades of the turbine rotor. Energy is thus supplied intermittently and at varying pressure and the approach to continuity is by multiplying the number of combustion chambers In the second system, typified in Brown-Boveri designs, the compressor delivers air continuously to a combustion chamber into which fuel is continuously sprayed and the resultant gases reach the turbine nozzle ring at "constant pressure."

There is a compromise system which, at least at the present stage of development, possesses certain attractive possibilities. A reciprocating diesel engine is very highly supercharged by a compressor driven directly from the engine crankshaft. The engine is proportioned so that all the mechanical power delivered is utilised in driving the supercharging compressor. Effluent gases from the engine cylinders drive the turbine and provide the sole source of useful energy of the complete unit. This, incidentally, is tantamount to an admission that in a reciprocating engine more energy escapes by way of the exhaust pipe than is delivered at the engine shaft. The Swiss firm of Sulzer Bros. has made great progress with this system for industrial power installations and has supercharged diesel engines to operate at the remarkably high mean effective pressure of 225 lb./sq. in. It is not essential to employ a conventional engine and compressor and, in fact, some advantage may be gained by diesel operated, free-piston compressors of the Junkers or Pescara types. These reciprocating units have no connecting rods or crankshafts. The two opposed engine pistons each carry a compressor piston and the motion is cushioned by air in coaxial compressor cylinders. Only a light linkage is necessary to synchronise the piston motion.

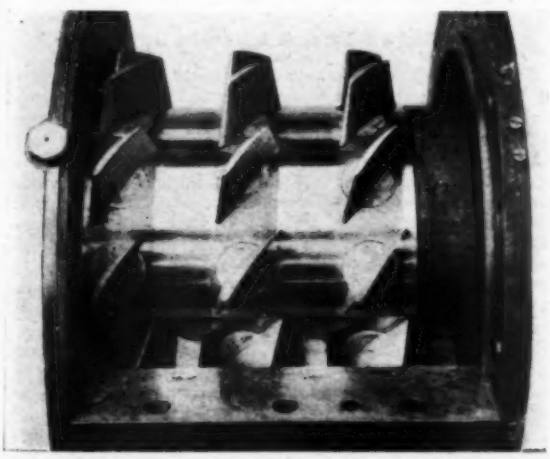

Fig. 4. Experimental Brown-Boveri axial compressor with adjustable pitch blading.

Recent Developments

In recent years, knowledge acquired by aerodynamic research on gas flow and airfoils has enabled more efficient rotary components to be built. The blades of modern compressors and turbines are of a carefully designed airfoil section, as will be seen in Fig. 2, illustrating the turbine rotor of the 2,000 h.p. Brown-Boveri set for a main line locomotive.

Concurrently, better heat resisting steels have been developed and turbines can now be operated continuously with a gas admission temperature of 1,000-1,100 deg. F. Thus the respective efficiencies of the complementary components have been raised and the overall efficiency improved. There are reasonably good prospects of further substantial progress in both components and some advantage can be gained by compounding and employing auxiliary heat exchange equipment.

Of course, an axial blower with fixed blading has only a limited range of air delivery volumes. With adjustable rotor blades, however, it could be regulated to deliver any volume from zero to maximum, and pressure from zero to maximum at constant speed. Such an innovation would be as important as the variable pitch airscrew has proved to be in normal aircraft propulsion. Fig. 4 shows the rotor of an experimental three-stage, high-speed blower of this type, built by Brown-Boveri for test purposes. The blades can be adjusted between 0 deg. and 45 deg., whilst running, and normal maximum air delivery is 6,395 cu. ft. per minute at a pressure of 2.1 atm. (30.9 lb./sq. in. absolute) at 7,800 r.p.m.

Gas Turbines in other Fields

As an independent power unit, the gas turbine may be regarded as in its infancy. Already, however, it can compete with diesel or steam plants in certain industrial applications where low first cost, small space occupied, and ability to be brought into immediate operation are important requirements. This applies with particular emphasis where liquid or gaseous fuels are available and water is scarce or unobtainable. They are used to generate electric power and for driving blowers for blast furnaces and chemical plants. Mention has been made of a 2,000 h.p. gas turbine locomotive built for the Swiss Federal Railway (see Fig. 3), and projects are at present under consideration for a 4,000 h.p. marine propulsion set driving through a two-stage reduction gear. In America, it was reported at the end of 1940, the Allis Chalmers Company built sets of Brown-Boveri type for generating electric power up to 6,000 kW. (approximately 8,000 h.p.) in the oilfields. Several such sets "have been operating almost constantly at full load since 1936." To-day, Brown-Boveri are able to build gas turbine electric generating plant for outputs up to 10,000 kW. (13,400 h.p.).

The overall thermal efficiency of these industrial sets is from 20 to 22 per cent for the simplest types. By

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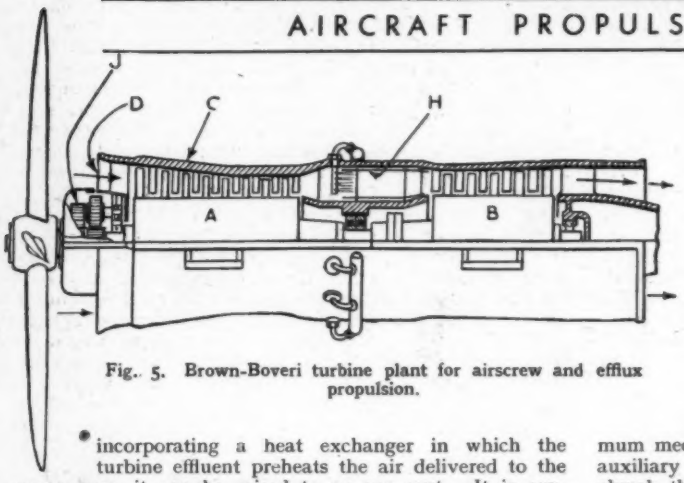

Fig. 5. Brown-Boveri turbine plant for airscrew and efflux propulsion.

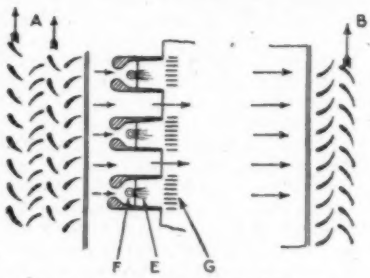

Fig. 6. Developed section of Brown-Boveri annular combustion space with mixing chambers and flame grids.

incorporating a heat exchanger in which the turbine effluent preheats the air delivered to the compressor, it can be raised to 24 per cent. It is confidently expected that before long the turbine inlet temperature will be raised to 1,200 deg. F. and efficiency will then equal that of a modern steam turbine plant. The Allis-Chalmers Company report one 6,000-kW. unit operating on an efficiency of 32 per cent.

Turbo Blowers

Exhaust gas turbines, employed as a source of auxiliary power for driving supercharging blowers for aircraft engines, have been under development since the last war. The Rateau was among the very first. G.E.C. types are now in regular production and in service on, for example, the Boeing "Flying Fortress," Thunderbolt and "Lightning" machines among others. The centrifugal blowers used for such applications may have a rotor peripheral speed of more than 800 m.p.h., that is, above the speed of sound. What is not so well appreciated is the wide adoption of exhaust gas turbo-blowers for stationary, marine and railway diesel engines. Over a year ago, Brown-Boveri announced they had built more than 1,500 sets for diesel engines having an aggregate output in excess of 1,600,000 h.p. It has been reported, too, that the new German stratosphere bomber has diesel engines with exhaust turbo superchargers—probably on the Buchi system.

The need to increase the output of aircraft power plants is more urgent in view of the call for huge freight-carrying aircraft for long-range oversea service. At the moment the largest seaplane in the world is the Glen Martin Mars, which has an all-up weight of 70 tons, can carry 20 tons of cargo across the Atlantic or accommodate 150 fully equipped soldiers. Its wing span is 200ft. and the power units are four eighteen-cylinder double-row radial engines, each of 2,000 h.p. The designer has stated that the next stage could be either a 125-ton or a 250-ton flying boat.

Demand for Larger Power Units

One outstanding problem connected with mammoth long-range aircraft of the future remains the engines to be employed, since 2,400 h.p. units represent at the moment of writing the height of achievement with aircraft petrol engines, though double H-type 48-cylinder engines of 5,000 h.p. are in the offing, as well as 3,000 h.p. multi-bank radial engines with eighteen or more cylinders having turbo-exhaust superchargers and driving six-blade contra-propellers. Such units would be extremely complicated and means of servicing them in flight would be necessary.

As a power unit for aircraft, the gas turbine plant may be adapted for either airscrew or jet propulsion systems. Whilst using the same two basic units, the air compressor and the turbine, it will be seen that the two systems necessitate the development of divergent types of plants. For airscrew drive the turbine is required to deliver the maximum mechanical energy and the compressor, virtually an auxiliary to supply air for combustion and cooling, must absorb the minimum mechanical energy. Conversely, in jet propulsion plant all the energy developed by the smallest practicable turbine is employed to drive the largest practicable compressor.

It is extremely difficult, and, incidentally, extremely dangerous to reputations, to indulge in prophecies regarding the lines of development of anything related to aircraft. The huge power output which will be required for monster aircraft of the future would appear to necessitate the use of rotary instead of reciprocating units. For ultra-high speeds or stratosphere flight, jet propulsion would seem to be the logical method. Turbine-driven airscrews, by using the existing highly developed technique, would possibly be more quickly realisable. This does not suggest the immediate or even the eventual demise of the reciprocating engine or that turbine-driven airscrews are merely a step on the way to jet propulsion. Probably all types will find their place for specific types of aircraft. As to the ultimate method of propulsion, it is too far ahead to do more than speculate. Despite all the difficulties, steam turbines cannot be entirely discounted. Probably, however, fuel will be the deciding factor. Eventually it may be desirable, or necessary, to employ fuels other than petroleum or coal-derived oils, and in such circumstances an entirely new technique may be required.

Propulsion by turbine-driven airscrews may reasonably be expected to materialise in the not-too-distant future. Let us examine briefly some of the projected schemes of various countries. Although some of them are but patented designs which have not progressed far beyond that stage, the schemes serve to show the trend of development.

Brown-Boveri Aircraft Unit

The plant shown diagrammatically in Fig. 5 is claimed to be of relatively simple construction, low weight and high efficiency. Outstanding features conducing to this end are (1) the arrangement by which the gas flow between compressor and turbine undergoes no substantial deflection or change in velocity, (2) the diminution of the axial velocity of the air in the compressor to that required for satisfactory combustion, (3) the provision of small passages serving as mixing chambers in the annular space between the compressor and turbine, and (4) the increase of the axial velocity of the gas as it flows through the turbine.

Compressor rotor A and turbine rotor B are on directly connected coaxial shafts and the stator blades of both components are mounted in a tubular casing C forming the main duct. Air enters at the annular inlet D and is compressed in the usual manner in the forward (convergent) section of the compressor. Thereafter the duct diameter is parallel and the angle of the rotor blades is decreased. Only 20 to 30 per cent. of the air delivered by the compressor is required for the combustion of fuel; the remainder is

AIRCRAFT PROPULSION SYSTEM

employed to lower the temperature of the combustion gases before they reach the turbine.

This small quantity of air is passed into a plurality of separate mixing chambers E in the annular space, as shown in the flat development diagram, Fig. 6. In these the air is further reduced in velocity and mixed with the fuel injected through nozzles F. Flame forms at or beyond the grid bars G, which furnish a number of friction surfaces along which the boundary layers of the mixture move at a lower velocity than the ignition velocity. Small flames are formed locally which preheat and ignite the main mass of the mixture and thus maintain stable conditions. The flaming mixture is reduced in temperature by the excess air which flows through the passages between the mixing chambers. To protect the walls of the annular space a shell H of heat-resisting sheet metal may be fitted. Cooling air passes between the shell and the walls.

Despite this plant is primarily intended to mechanically drive an airscrew through reduction gear J, the turbine effluent is employed to give a supplementary propulsive effort by jet reaction. The turbine, therefore, differs from the usual type, which is of increasing (divergent) diameter to reduce the gas velocity and exploit the gas expansion in order to minimise exhaust losses. To be effective for propulsion the gas outlet velocity should be about 1.5 times the flying speed of the aircraft. Accordingly, the turbine is substantially of parallel diameter and the rotor blade angle is progressively increased towards the outlet to raise the gas velocity at the discharge nozzle.

[*A second instalment in the next issue will review other aircraft propulsion systems embodying turbines and airscrews.*]

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6. H.M. Ships c/o G.P.O. London (including merchant ships on Government non-commercial service) serving in the Eastern Mediterranean, including Malta and the Red Sea, and the East Indies Station, including the Persian Gulf and in East African waters.
7. Merchant ships on ordinary commercial service, i.e., vessels other than those whose address is c/o G.P.O. London, calling at ports in areas covered by 1—5 above.
8. Force Overt c/o G.P.O. London, if serving in areas covered by 1—5 above.
9. Forces c/o Army P.O. followed by a number, if destined for or serving in areas covered by 1—5 above.
10. Fighting French Forces, if serving in areas covered by 1—4 above.

The new air letter is a lightweight closed communication similar to that used by the troops in the Middle East in the service to this country. The charge for the air letter will be 6d. and transmission will normally be by air throughout to the appropriate base.

It would not be possible, even with the additional aircraft capacity, to convey all the way by air the weight of air letters which would be posted for Christmas delivery if the new facility were introduced immediately, but it will be brought into operation, as soon as the Christmas rush has subsided, on a date to be announced later.

On the introduction of the new service the air postcard service will cease. Users of the postcard service will then have the option of using the airgraph, which will still be available at the rate of 3d., or the air letter at a cost of 6d. As there is at present no airgraph service to Malta, the threepenny postcard service to the Island will be retained exceptionally.

The airgraph, which will continue to receive first priority for all-air conveyance over other air mail correspondence, will remain the cheapest, and normally the most expeditious, means of communicating with the Forces.

In view of their weight, ordinary air mail letters for the Middle East and beyond, for which the charge will remain at 1s. 3d. a half-ounce, will continue to be sent by sea to a port in Africa for onward transmission to the base in the theatre of operations.

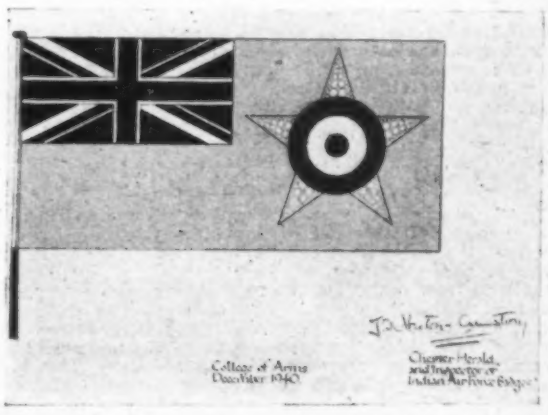
Forms for the new air letter service will be made available at the appropriate time at Post Offices generally and will be obtainable only on prepayment of the air postage rate of 6d. No other type of form can be allowed and no enclosure can be permitted. Meanwhile, the public are asked to post airgraphs and air postcards intended for Christmas delivery to the Forces in the Middle East and beyond as soon as possible, and not later than Monday, November 16th.

That Marauding Boston

SHOALS of letters have reached us from readers who ask if we did not make a mistake in stating, in the inscription to the picture on page 375 of our October 1st issue, that one of the aircraft in the background was a Boston, and that in fact it was a Marauder. One reader, who signs himself "Aircraft Pencil Pusher," breaks into rhyme:

You must agree,
The Boston III
Can also be a *Havoc*,
But Marauder I
It's never done—
So please clear up the havoc.

We know from evidence that readers study *Flight* carefully, but even we were surprised to discover that a slip of this sort, occurring in a by no means conspicuous position, was spotted by so many. Such proof of thoroughness on the part of our readers is very welcome.



The flag of the Indian Air Force. Tricolour roundels are superimposed on the Star of India with a Union Jack upon a sky blue ground.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

SEVERSKY SPEAKS OUT

Quality of Axis Aircraft

I WOULD like to congratulate you on the publication of such very pertinent home-truths as those in your October 1st issue concerning the performance of American aircraft.

While the subject is to the fore, may we go one stage further and try to de-bunk the popular idea that all German planes are, *ipso facto*, inferior to those of the Allies?

Those of us who examine and sometimes test captured German equipment are under no illusions whatsoever. Even the Sunday papers are just beginning to see things in perspective after three years of war. I quote from an article printed a week ago: "As F.W. 190s are the fastest fighters in the world . . ." And again, in the same column: "The Ju 86P1, which has been over Britain and bombed us from a height of seven miles . . . this bomber has never been caught. It is well out of A.A. and normal fighter range."

What a contrast to the style of 1939 and 1940!

As a matter of life and death we should always assume that German equipment is better than our own, then there is a perpetual urge to improve, and not take it for granted that we have a monopoly of superiority.

JOHN V. HEWES.

FAULTY FILMS

Errors That Annoy the Initiated

LATELY on going to the cinema to see films about aircraft I have been noticing the amount of mistakes made.

In the film "Captains of the Clouds," when a squadron of Hudsons are coming over from Canada they are attacked by a (supposedly) Messerschmitt ME109E, which turns out to be a Hurricane painted in the German colouring and markings. Also this aircraft is off the Irish coast and using up hundreds of rounds more than it could carry. Then consider the petrol; this aircraft is a long way from France, but after about a quarter of an hour's shooting up of the Hudsons, one of the Hudson pilots says they will have to get rid of him as he will wait for the next flight of bombers! Well, that was the limit.

Then in "The Day Will Dawn," a Wellington starts out for Norway to drop a secret agent, but changes into a Whitley troop carrier off the Norwegian coast.

Another thing that puzzled me was in "Ships With Wings." Why should a Fulmar go on escort without any ammunition and consequently have to ram a Breda 88 in order to destroy it?

In my opinion, "A Yank in the R.A.F." was very poor. You could see the strings that held up the models, and the "Spitfire" which he flew appeared to be made of cardboard. Over Dunkirk the Stukas were like flies round a jampot; I don't know how they missed each other!

Of course, most people do not notice such things as these, but to my friends and myself, who take a great interest in aircraft, we find it very annoying. ALBERT FISHER.

TEST PILOTS

Suggested Grading by Rank

I AS a civilian test pilot of over four years' standing and with a total of 4,000 R.A.F. and civilian flying hours, heartily endorse the suggestions outlined by "Test Pilot" in *Flight* of September 10th, 1942.

I have often considered putting a similar scheme on paper and submitting it to "M.A.P.," but have refrained for the simple reason that I thought "M.A.P." would reject it on the grounds that, production being what it is, it would not be an opportune time to bring such a scheme into force. However, as production is well under control now, I suggest that the S.B.A.C. and/or the G.A.P.A.N. call a meeting of firms' test pilots (and perhaps representatives from the A. and A.E.E.) and prepare a scheme for submission to the Minister of Aircraft Production and the Director of Technical Development.

In the scheme I suggest that instead of all so-called test pilots coming under the one heading, they are graded in something the same way as are C.F.S. instructors and given rank accordingly. For example, a test pilot of the highest experience and ability (and there are, to my knowledge, only about half a dozen in the country) is easily worth the acting rank and pay of a group captain, while the competent civilian type with no military training at all (who has ostensibly become a production test pilot to avoid military service and who has no ambition and/or ability to make the work of aircraft testing a career) should be given the lowest grade.

Under this test pilots scheme I consider:—

(i) The Treasury would save tens of thousands of pounds per year.

(ii) Test pilots would be happier because

(a) they would be paid more in keeping with their ability and experience, and

(b) they would be working more for the customer than for the production manager, which is not the case as things are at present.

With reference to the editorial comment on the subject, I very decidedly disagree with the remark that test pilots do not generally agree about the characteristics of a particular type; in my experience *first-class test pilots* invariably do, but, as I have said before, there are very few who are eligible to go into Grade I of the scheme!

FLIGHT-LIEUTENANT, R.A.F.O.

CONTROL OF THE RUDDER

Handlebars for Prone Position

MR. A. W. FELTON'S letter to *Flight* of October 1st relating to a rotating stick rudder control is of great interest to me, because some time ago I had a similar idea.

I had made a "mock up" cockpit for a prone position, in order to find a suitable arrangement for the instruments and controls. I found that when lying on one's stomach it was very hard to use a rudder bar. So I devised a control system similar to Mr. A. W. Felton's idea.

The elevators were controlled by moving the stick in the normal fashion, and the ailerons were controlled by "two segments of a wheel" moved in a semi-rotary movement, the rudder being controlled by pulling or pushing "the two segments of a wheel" like the handlebars of a bicycle.

And, although it never occurred to me before, it was actually arranged in Mr. A. W. Felton's "natural" manner. Perhaps this was because I regarded the rudder control as a pair of handlebars. EX-STUDENT (C. Æ.).

Odd Systems of Early Types

I NOTICE that Mr. A. W. Felton asks whether there is any further justification for the continued existence of the rudder-bar in modern aircraft. Actually, what really is the matter with the rudder-bar as we know it?

The main criticism levelled against it seems to be that it works the wrong way about, but although that may be a debatable point, it at least has the merit of being a very simple form of control.

The idea of combining three separate movements in one control column was never counted much of a problem to the "technicians of those early days"—for many control arrangements were successfully designed and used in this form—notably in this country by S. F. Cody.

In the beginning of things some very odd control systems certainly existed, the strangest of all being, perhaps, the arrangement used by the Wright Brothers in which all the controls were manipulated by two sticks. How the pilot decided to do what, with which, and when, I could never understand. Incidentally, there was no rudder-bar, which fact only added further complication to the puzzle of the sticks. Mechanically simpler, but no less difficult to sort out in operation, was the two handwheel system employed in the Antoinette monoplanes. In this case a rudder-bar was fitted, but no one seemed to get much fun out of those two wheels other than the famous Hubert Latham.

At the other end of the scale Dunne showed how most of

CORRESPONDENCE

this odd business with wheels and sticks could be done without, as actually the only control needed with his machine was a simple steering wheel; the rest of things could be regarded more in the light of gear levers—car fashion—for climb and descent, and were certainly not required to keep things right side up. In this comparison, however, it must be admitted that the Dunne was possessed of an extraordinary degree of inherent stability, whereas the Wright in its original form was the most unstable thing ever to take the air.

The present-day form of control, in all essentials, is the same as that employed by Esnault-Pelterie and Blériot and to a certain extent Voisin. It has not survived merely as a survival of other days, but because it is eminently suited to its job.

Some wonderfully docile aircraft exist nowadays which would not be unduly perturbed if deprived of their rudder control, but while we find it desirable to fit rudders, some means must be provided to operate them. For this purpose what is better than a pair of ordinary feet and a rudder-bar? The job is simple, and, after all, one does not steer to inches with an aircraft as with a car, but a far more precise degree of control is needed at the handwheel or control column in the fore and aft sense, as in the case of landing. Therefore it would seem that the less there is to twist and juggle with at this end of the job the better, particularly as it is, in the main, a one-hand job.

To give some idea of how really well off the present-day pilot is in the matter of controls, I would like to see a historical survey, illustrating the "stepping stones," given in the pages of *Flight*. It might be concluded that, after all, the much-maligned rudder-bar is a very neat and simple sort of tool!

S. H. BOSTOCK.

FUEL CONSERVATION

Another Idea for Utilising h.p. Output

I have been very interested in recent correspondence published in *Flight* regarding the utilisation of power developed by aero engines on test.

I agree that the simplest method would be to couple the engine to a d.c. generator and use the latter to charge a set of batteries.

However, I would point out that 1,000 to 1,500 h.p. would require some dissipation via batteries. Furthermore, most power equipment in factories to-day is of the a.c. type, which, unfortunately, would rule out the use of the stored energy.

My suggestion is that the test plant drive a 3-phase alternator of suitable k.v.a., speed, and voltage in order that it may work in parallel with the electric power supply already feeding the factory. This would greatly augment things, especially at peak loads.

A. J. TWITCHETT.

Rugby.

ASTRO-NAVIGATION

Speedy Method Without Costly Instruments

WOULD that I were familiar with the interesting instruments mentioned by Captain Loraine. However, in so far as they affect the matter under discussion I dare to guess that they are expensive, delicate and heavy compared with the Star Chart which once engraved can be printed by, and for, the million and is therefore more possible for most of us.

The method set out not only avoids the use of such costly instruments, but is, I believe, the speediest of all general methods of finding a position. The chart can be drawn to any scale so that the accuracy of the determinations need only be that of the observations.

Although essentially *laudator temporis acti*, I see no use in trying to evade the fact that Grandpa's mathematical methods are bound to be used less and less, are, in fact, being used less and less by navigators. They cost too much in time and risk of error to be used except in emergencies.

As for Hour Angle, I had to modify its meaning or use, say, Negative Right Ascension—and Trigonometer for Clock!

To find position is one problem. We solve it by the simplest and shortest known method. To find Greenwich time is a problem apart. If the navigator, instead of using the simple method, works out his position from the almanac, his G.M.T. must be as accurate as possible. He needs a chronometer. If the simple method is used, his G.M.T., if wanted at all, can be got from an ordinary watch. If he insists upon greater precision he must carry a chronometer. Even so, as speed is so important it is ridiculous to contend that he might just as well find his position by the slow means of long and complicated sums with their attendant risks of error, instead of taking the short cut. Surely take the bridge over the river rather than the long road round.

G.M.T. is not a factor. All the position lines upon the Star Charts are plotted without reference to G.M.T. Are they no good! Better still, let Captain Loraine stand in his garden and by our method find his position. An hour later do it again. He will still be there! Clearly, then, it is not true that "It is no good plotting any position line of any sort unless G.M.T. is put against it."

I am humbled, not by this very gallant officer's criticism, but by his splendid performance with the *Clyde* of which I have just read in *Flight*.

A. L. MIEVILLE.

A HOME AIR GUARD

For Liaison With the R.A.F.

MR. G. R. BRANDRETH'S letter in the issue of September 17th on the subject of the Home Air Guard is of definite interest, and I consider that something of the sort should be formed immediately.

I put a suggestion for a similar body up to the War Office on February 5th last. The suggestion was duly "noted," and apart from that nothing further has transpired.

My original suggestion was for a corps of air officers and men to be formed for liaison between the Home Guard and R.A.F., to act in the same way with the Home Guard for Army Co-operation work as the Army Co-operation Squadrons do with the Regular Army, and to assist in the defence of stations as do the R.A.F. Regiment, etc.

The older types of aircraft could be used for the training and general work, and in the event of an invasion attempt even an old biplane armed with a few machine guns could make a mess of parachute troops landing, gliders and other forms of slower transport.

For officers to man the proposed corps I would suggest that these be drawn from A.T.C. officers and the Home Guard.

Apart from a few schoolteachers, the majority of the A.T.C. officers are either ex-pilots and observers of the last war, or have some special technical qualification which would fit them for this work.

Short training courses could be arranged to permit suitable candidates to qualify again for their "wings," and it should not be very difficult to arrange for the necessary co-operation from the Air Ministry in this respect.

GEO. L. COOPER, B.SC.

THE TORPEDO BOMBER

Another Suggested Specification

I READ with interest the article on torpedo aircraft (*Flight*, September 17th), and I would like to submit my views on this form of aircraft. Here are what I think should be its chief characteristics:—

(1) To carry two 21in. torpedoes.
(2) To have a total of over 4,000 horse-power.
(3) To have a landing speed of 80-90 m.p.h., to have fairly small wing area (400-500 sq. ft.), and so give it a top speed of 350-400 m.p.h.
(4) No defensive armament.
(5) Large airscrews to absorb power (three-bladed, 10ft. diam., variable pitch).
(6) Weight loaded, 16,000-20,000 lb.
(7) Long range, 1,000-2,000 miles, therefore two-way wireless and crew of two or three.
(8) Tricycle undercarriage.
(9) Fuel carried in wings.
(10) I do not know whether the idea of arrowplanes or tailless planes is unsound, but this sort of plane seems to me to be an excellent idea for torpedo aircraft. The arrowplane actually has a larger tailplane area than conventional types, for the tailplane is incorporated in the wing tips. The fin and rudder could be placed at each wing tip, and the backswept wings given slight dihedral. Also the directional stability of an arrowplane is greater than in any other form of aircraft. The elevators could be used as ailerons.

R. HUDSON.

Back Numbers Wanted

PAPER shortage has been responsible for readers sometimes missing their copies of *Flight*. Other and more fortunate readers will be rendering a service to them by parting with such copies when they have finished with them and sending them to this office. The following are required: "S.I.," August 6th, 1942; "F.W.B.," August 13th, 1942; "A.J.C.," September 3rd, 1942.

BEFORE A BOMBE

Four Pages of Photographs Which De... a Halifax Receives in the Cou...

1. A Handley Page Halifax at its dispersal point, overhauled and ready for the night's operations.

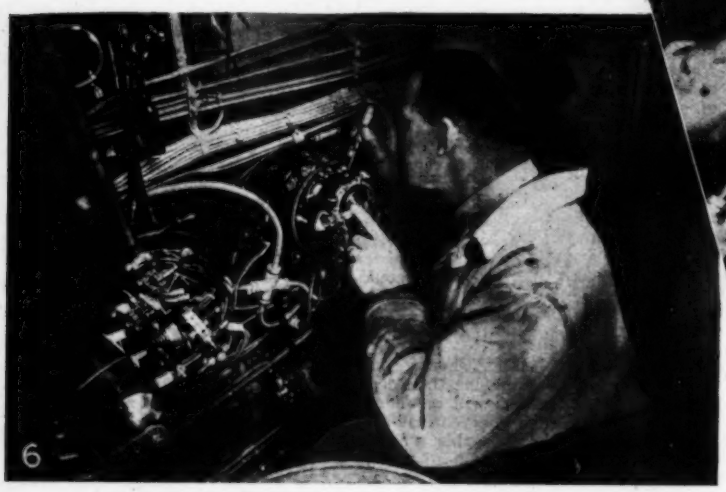
2. The Rolls-Royce Merlins and their auxiliary equipment get their daily attention.

3. A spinner is removed to attend to the Rotol airscrew.

MAINTAINING our air offensive over Germany is so frequently thought of only in terms of aircraft output and replacement, that the problems of servicing and overhauling—or, in other words, keeping machines operationally airworthy—is often forgotten. To illustrate these points we have selected a Halifax, not because that type is any more complicated than any other four-engined heavy bomber but because it is representative of its type.

In the 1914-18 war the proportion of aircraft on charge to personnel employed was 22,171 to 291,152. They were very simple types by comparison with the complicated structures which now take their loads of five, six or seven tons of bombs to Germany, and when one remembers all the people employed, apart from the uniformed personnel actually handling the aircraft, the numbers must to-day amount to many thousands per machine. There are, for instance, those who dig the metal from the earth and those who smelt it. There are those who bring material from across the globe in ships

4. An L/A.C.W. of the W.A.A.F. tests the sparking plugs under pressure.



5. All the multiplicity of instruments receive a daily inspection and check for function and accuracy.

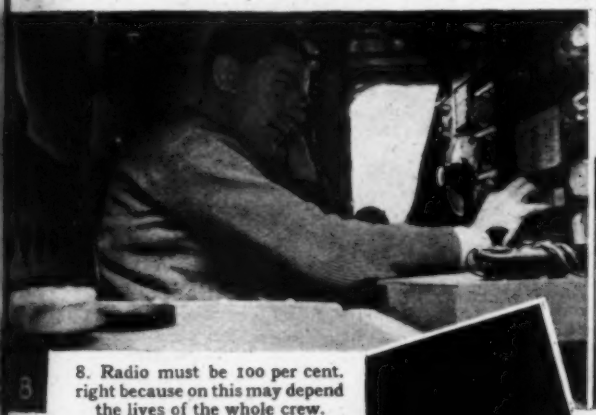
6. "George," the automatic pilot, is adjusted by a highly skilled instrument repairer. This picture also shows a little of the complicated electric wiring and "plumbing" of modern aircraft.

BE TAKES OFF

...me of the Many Attentions ... Operational Flying

and the employees of the aircraft industry who fabricate the aircraft. Each operational bomber must also be debited with its share of training aircraft and training personnel. Hospital staffs, records, transport, equipment and finance all contribute their quota. Finally, all these people, whose whole time is employed in producing aircraft, have to be fed, clothed and housed. When all this is considered, it makes one realise how far the country has marched from the single-figure bomber raids of 1940 to the four-figure raids of 1942.

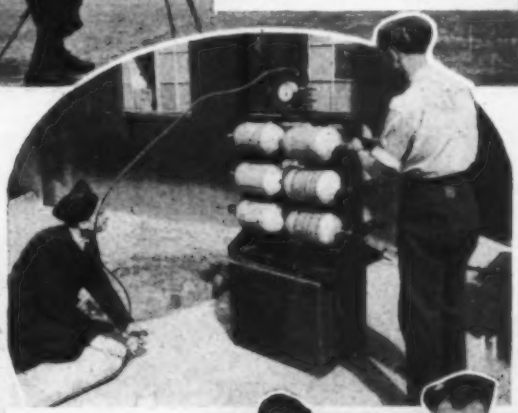
7. Inter-com. is of vital importance and must be free from crackles and bangs.



8. Radio must be 100 per cent. right because on this may depend the lives of the whole crew.

9. The navigator himself checks the compasses in the Halifax with the aid of an external instrument.

10. Oxygen bottles have to be filled to ensure a plentiful supply at altitude.



11. A supply of compressed air is necessary.

12. Hundreds of gallons of high grade fuel is pumped aboard.

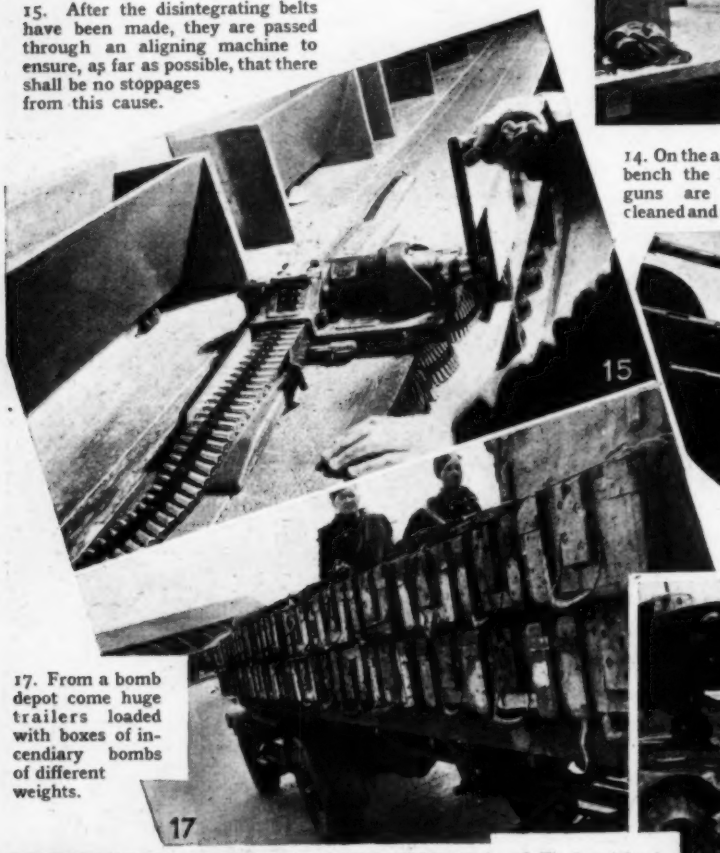
13. Making belts of small arms ammunition by machine. The links are in the tall upright container and the rounds are fed into the hopper.

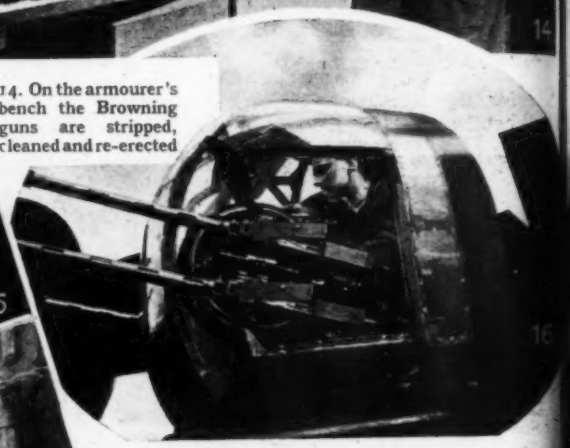
BEFORE A BOMBER TAKES OFF

To what size these raids may grow before Germany throws up the sponge can only be a matter for conjecture. But it is not difficult to foresee the time when the Americans and ourselves, working in double harness, will be able to find 2,000 bombers to raid any target in the Reich.

14. On the armourer's bench the Browning guns are stripped, cleaned and re-erected

15. After the disintegrating belts have been made, they are passed through an aligning machine to ensure, as far as possible, that there shall be no stoppages from this cause.

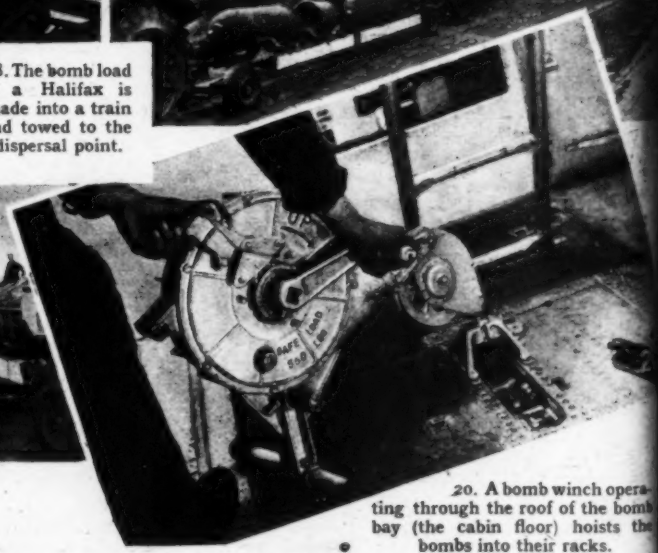




16. Guns are replaced in the power-operated turrets and the working of the turret checked.

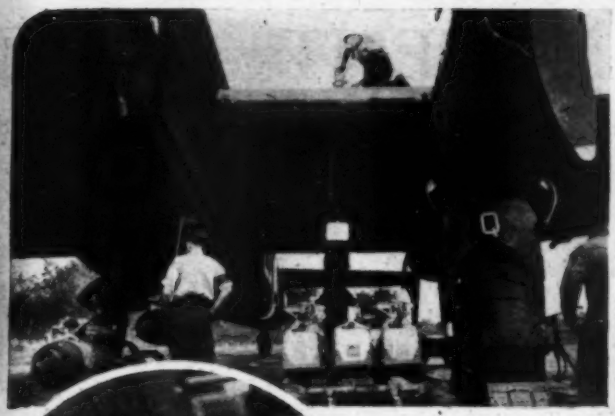
17. From a bomb depot come huge trailers loaded with boxes of incendiary bombs of different weights.

18. The bomb load of a Halifax is made into a train and towed to the dispersal point.



19. Carriers being fitted to 1,000-lb. bombs before hoisting them into their appointed position in the main bomb bay. The bombs are arranged in such a manner as to take their proper place in the "sticks."

20. A bomb winch operating through the roof of the bomb bay (the cabin floor) hoists the bombs into their racks.

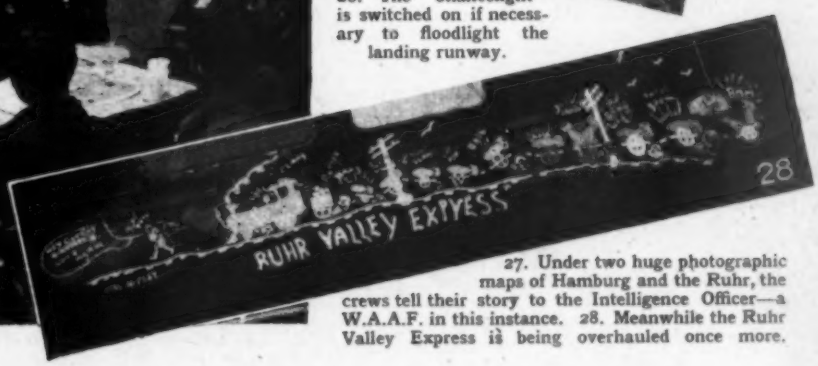


22. While the Halifaxes are being prepared, the aircrews are "briefed" by the Wing Commander for the night's raid and the navigators work out their courses.

21. Containers of 30-lb. incendiaries being stowed in the port wing racks.
23. Wearing parachute harness and flotation jacket, the rear gunner checks the auxiliary ammunition chutes amidships.
24. The pilot takes his place at the controls and the Halifax takes off on another operation.

25. On their return the aircrews appreciate a hot cup of tea while telling their story.

26. The "Chancelight" is switched on if necessary to floodlight the landing runway.



27. Under two huge photographic maps of Hamburg and the Ruhr, the crews tell their story to the Intelligence Officer—a W.A.A.F. in this instance. 28. Meanwhile the Ruhr Valley Express is being overhauled once more.

IN PARLIAMENT

Post-war Air Freighters : Shoes for Airmen : W.A.A.F. Clothing : Age Limit for Ferry Pilots : Raid Localities : Ground Training of Aircrews

Air Crews' Footwear

Mr. Perkins asked the Secretary of State for Air whether he will consider allowing air crews to wear shoes instead of boots while in the air?

Sir A. Sinclair: There is no rule that flying boots must be worn, but the practice in operational commands is to wear them because they give ankle support in the event of a parachute jump. In non-operational commands shoes may be worn by officers at the discretion of Commanding Officers.

Cargo Carriers

Captain Strickland asked the Minister of Aircraft Production what steps are being taken to plan for a large future construction of cargo-carrying aircraft in this country to meet post-war needs; and whether, in view of the peacetime importance of this means of transport as well as its wartime value, he will now set up a special commission of expert engineers and business men to consider the whole problem and report?

Colonel Llewellin: While the Government intends to deal with this matter at the appropriate time, I am afraid that at the present stage of the war the whole effort of the expert engineers of the aircraft industry must be concentrated on work for war purposes.

P.T. Kit for W.A.A.F.

Major Proctor asked the Secretary of State for Air whether it is proposed to make a free issue of physical training kit to all women in the Women's Auxiliary Air Force?

Sir A. Sinclair: This question is now under consideration.

Wing Cdr. Grant Ferris asked the Secretary of State for Air whether he is aware that numbers of Women's Auxiliary Air Force personnel will be serving at balloon sites this winter; and, bearing in mind that this is arduous work for a woman, whether he is satisfied that there is an abundance of warm clothing, other than the usual issue, available for aircraftwomen on duty at Balloon Command sites?

Sir A. Sinclair: The standard issue of clothing to W.A.A.F.'s is supplemented in the case of those employed at balloon sites by the issue of working serge suits, ankle boots and blue-grey socks and sweaters. There are ample stocks of these articles.

A.T.A. Pilots

Major Marlowe asked the Minister of Aircraft Production whether he is aware that Captain B. T. Monier-Williams passed the necessary flying test for training as a pilot in Air Transport Auxiliary in February, 1941; was told by the chief instructor that he would be required to report as soon as it was possible to provide him with the requisite training; that this ex-officer has exceptional qualifications, including experience in all three Services and in civilian flying; why, as vacancies exist, he has not yet been required to report; and upon what grounds, as he is eligible so far as age and physical fitness are concerned, he has recently been informed that he is considered unsuitable when older men of lower medical grade have been accepted?

Colonel Llewellin: The answers to the first two parts of the Question are Yes, Sir. In regard to the third, the report on the gentleman referred to contained the comment that he had done no flying since the last war and would require complete training on modern types of aircraft. In the light of recent experience the age limit for entry into the A.T.A. for anyone who lacks experience in modern types has been fixed at 32, and I regret that it is therefore impossible to admit a man who was born in 1892. I should, however, like to express my appreciation of Captain Monier-Williams' keenness so patriotically to wish to undertake this important duty.

Washington Interview

Maj. C. S. Taylor asked the Secretary of State for Air what appointment A.V-M. Lloyd now holds; whether his attention has been drawn to reports of an interview given by this officer in Washington; and whether he authorised the statements in that interview.

Sir A. Sinclair: A.V-M. Lloyd has been appointed Senior Air Staff Officer at Headquarters, Royal Air Force, Middle East. I am responsible for what the Air Vice-Marshal said in his very successful interviews with the Press in Washington. I am not responsible for statements which were incorrectly attributed to him.

Maj. Taylor: Can my right hon. Friend say that the very damaging statements which were reported in the Press were untrue, and, if so, will his Department consider publishing a denial?

Sir A. Sinclair: No, Sir; but if the hon. and gallant Member has any statement in mind and will ask me about it, I will gladly give him an answer. This officer is the very gallant officer who commanded the air defence of Malta during the worst months of the blitz, and the interview he gave in America at a time when there was a good deal of depression about the war and the description he gave of the gallant resistance of Malta to air attack were of the utmost value to the Allied cause.

Gien Photographs

Flight-Lieutenant Etherton asked the Secretary of State for Air what is the date of the photograph released by the Air Ministry and published showing the Gien tank farm in occupied France before it was bombed; and whether an inquiry is being held into the matters which a comparison of the two photographs published reveal?

Captain Balfour: Particulars of the dates on which reconnaisssance flights are carried out and of their objectives would certainly be of value to the enemy. Similarly the enemy would like to know the considerations that govern our bombing of particular places on particular occasions. In these circumstances, I regret that I am unable to give a detailed reply to this Question. The bombing of this exceptionally difficult target was remarkably successful and there is no issue calling for an inquiry.

Mr. Liddall asked the Secretary of State for Air the dates of the photographs taken of Gien before and after bombing which were supplied by his Department and which were published in the Press on August 30?

Mr. A. Sinclair: I would refer my hon. Friend to the reply given to-day to my hon. and gallant Friend the Member for Stretford (Flight-Lieutenant Etherton).

Enemy Raids

Sir R. Glyn asked the Secretary of State for Air whether he will consider the revision of the present regulations in regard to the publication in the Press of localities attacked by enemy aircraft in this country in view of the anxiety caused to those who are away from home on work of national importance and who are left in doubt as to the particular place in the area which is mentioned in the papers and frequently listen-in to the German broadcast in order to gain some information.

Sir A. Sinclair: The possibility of giving a more precise indication of the locality in which bombs have been dropped has been considered on numerous occasions and the official communiqués contain as much information as can safely be published without helping the enemy. The German broadcasts are not, of course, a reliable source of information on this or any other subject.

Aircrew Candidates

Major Profumo asked the Secretary of State for Air whether he is aware that there are numbers of men who have volunteered to join the Royal Air Force as air crews and, having been accepted on those terms, are drafted to ground jobs, in some instances for periods amounting to over 12 months, before there are opportunities for them to train as air crews; and, in view of the discontent caused by these conditions, whether he is prepared to curtail the intake of volunteers for air crews to a number that can be immediately absorbed?

Captain Balfour: Air-crew candidates, other than wireless operator-air gunners, undergo a short period of essential ground training before commencing their training in the air. Wireless operator-air gunners, to which category of air crew my hon. and gallant Friend is presumably referring, require a long period of ground training in wireless duties before they are fit for air-crew training. Moreover, in order to ensure that adequate numbers are readily available to meet fluctuating operational requirements, wireless operator-air gunners who have completed their ground training are employed as ground wireless operators until required for training in the air. The period thus spent upon ground duties, which in some cases has been unavoidably prolonged, is rapidly becoming shorter generally.

Service Aviation

Pilot of a night intruder Boston getting aboard. The navigator/bomb-aimer can be discerned in the nose cockpit.

Royal Air Force and Fleet Air Arm News and Announcements

Promotions

The London Gazette, September 29th, 1942.

GENERAL DUTIES BRANCH.

Air Comdres. (temp. Air Vice-Marshals) to be Air Vice-Marshals :—

J. H. D'ALBIAC, C.B., D.S.O. March 15th, 1942.
J. M. ROBB, C.B., D.S.O., D.F.C., A.F.C. July 1st, 1942.
G. C. PIRIE, C.B.E., M.C., D.F.C. July 15th, 1942.

Grp. Capts. (temp. or war sub. Air Comdre.) to be Air Comdres. :—

R. L. G. MARIX, C.B., D.S.O. September 21st, 1941.
L. H. SLATTER, C.B., O.B.E., D.S.C., D.F.C. (Act. Air Vice-Marshal). October 1st, 1941.
A. H. ORLEBAR, C.B.E., A.F.C. (Act. Air Vice-Marshal). February 22nd, 1942.
A. LEES, C.B.E., D.S.O., A.F.C. (Act. Air Vice-Marshal). March 1st, 1942.
R. B. MANSELL, C.B.E. March 9th, 1942.
C. R. CARR, C.B.E., D.F.C., A.F.C. (Act. Air Vice-Marshal). July 1st, 1942.
A. DURSTON, C.B., A.F.C. (Act. Air Vice-Marshal). July 15th, 1942.
H. E. P. WIGGLESWORTH, C.B.E., D.S.C. (Act. Air Vice-Marshal). July 20th, 1942.

TECHNICAL BRANCH.

Air Comdre. (temp. Air Vice-Marshal) A. S. MORRIS, O.B.E., to be Air Vice-Marshal. June 4th, 1942.

Grp. Capts. (temp. Air Comdres.) to be Air Comdres. :—

V. H. TAIT, O.B.E. (Act. Air Vice-Marshal). March 15th, 1942.
O. G. W. G. LYWOOD, C.B.E. March 4th, 1942.

Awards

Fleet Air Arm

THE KING has been graciously pleased to approve the following awards for bravery in air operations in the Middle East :

DISTINGUISHED SERVICE CROSS.

Temp. Lt. (A) E. L. RUSSELL, R.N.V.R.
Temp. Sub.-Lt. (A) D. M. JUDD, R.N.V.R.

Royal Air Force

THE KING has been graciously pleased to approve the following appointments for gallant and distinguished services in the combined attack on Dieppe :—

DISTINGUISHED SERVICE ORDER.

Air Cmdre. A. T. COLE, C.B.E., M.C., D.F.C., R.A.A.F.

O.B.E. (MIL.).

Act. Sqn. Ldr. P. J. B. REYNOLDS, R.A.F.V.R.
Act. Sqn. Ldr. J. H. SPROTT, R.A.F.V.R.

M.B.E. (MIL.).

Act. Flt. Lt. G. L. B. KIDD, R.A.F.V.R.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy :—

BAR TO DISTINGUISHED FLYING CROSS.

Sqn. Ldr. W. W. MCCONNELL, D.F.C., R.A.F.V.R., No. 22 Sqn.—Since being awarded the D.F.C., Sqn. Ldr. McConnell has led his squadron in a number of successful offensive operations, which have included attacks against enemy shipping, docks and airfields. He also participated with distinction in the combined operations at Dieppe on August 19th, 1942.

Sqn. Ldr. P. R. W. WICKHAM, D.F.C., No. 111 Sqn.—During the combined operations at Dieppe on August 19th, 1942, Sqn. Ldr. Wickham led his squadron in the first sortie before dawn and in a further four during the same operations. He has personally destroyed nine enemy aircraft, probably destroyed five and damaged several others.

Flt. Lt. D. A. G. PARRY, D.F.C., R.A.F.V.R., No. 105 Sqn.—In August, 1942, Flt. Lt. Parry and P/O. Robson were pilot and navigator respectively of an aircraft detailed to attack a target in Germany in daylight. In spite of difficulties, and in the face of intense anti-aircraft fire, the target, which was comparatively small, was vigorously attacked from a low level and hits were made. Throughout, Flt. Lt. Parry and P/O. Robson, whose skilful navigation was of the greatest assistance, displayed great courage and determination to achieve success. Both these officers have completed numerous sorties.

DISTINGUISHED FLYING CROSS.

P/O. V. G. ROBSON, R.A.F.V.R., No. 105 Sqn.—For citation see Flt. Lt. Parry.

Wing Cdr. H. P. JENKINS, No. 31 Sqn.—During the operations in Burma and the Far East this officer displayed inspiring leadership, especially

Wing Cdr. R. P. H. Gibbs, D.F.C. No. 30 Squadron, who has been awarded the D.S.O.

SERVICE AVIATION

Sqn. Ldr. R. W. Oxspring, No. 72 Squadron, who was recently awarded a Bar to his D.F.C. He has 7 enemy aircraft to his credit.

during the evacuation and when dropping supplies.

Act. Wing Cdr. W. H. BURBURY, A.F.C., No. 31 Sqn.—In the operations in Burma and Assam this officer carried out a large number of hours' flying in the face of great difficulties.

Sqn. Ldr. K. F. MACKIE, No. 31 Sqn.—During the operations in Burma this officer performed much valuable work, especially in the dropping of supplies and during the evacuation. On one occasion he courageously landed his aircraft on rough ground and rescued 23 persons from Fort Hertz.

Act. Sqn. Ldr. N. H. BRETZ, R.C.A.F., No. 402 Sqn.—Sqn. Ldr. Bretz has completed many operational sorties, including four low-level raids in Hurricane bombers, as a result of which two enemy destroyers were severely damaged. During the combined operations at Dieppe on August 19th, 1942, he led his squadron in four sorties and destroyed one enemy aircraft and damaged another.

Act. Sqn. Ldr. L. V. CHADBURN, R.C.A.F., No. 416 (R.C.A.F.) Sqn.—During the combined operations at Dieppe on August 19th, 1942, the squadron destroyed three enemy aircraft, probably destroyed one and damaged seven others without loss to themselves. This achievement reflects the greatest credit on this officer's excellent leadership, and he has inspired confidence in those under his command. He has personally destroyed one enemy "E" boat, and has probably destroyed a Ju.88 and damaged other enemy ships and aircraft.

Act. Sqn. Ldr. P. B. G. DAVIES, R.A.F.V.R., No. 19 Sqn.—This officer has participated in sorties over enemy-occupied territory as well as in several attacks on shipping. On one occasion, in March, 1942, he led a formation as escort to a force of bombers detailed to attack the airfield at Abbeville. Some 30 enemy fighters attempted to intercept the bombers, but their efforts were frustrated. Sqn. Ldr. Davies, displaying extremely skilful leadership, contributed materially to the success achieved. In the combined operations at Dieppe on August 19th, 1942, his fine qualities were well to the fore. Sqn. Ldr. Davies has destroyed at least two enemy aircraft.

Act. Sqn. Ldr. D. G. SMALLWOOD, No. 87 Sqn.—This officer is an exceptionally keen and skilful pilot, who has rendered excellent service, especially in night-flying operations. In the recent combined operations at Dieppe, Sqn. Ldr. Smallwood led his squadron on two low-level attacks on gun emplacements in the face of strong opposition from the ground defences; his leadership proved a valuable asset.

Act. Sqn. Ldr. E. R. THORN, D.F.M., No. 32 Sqn.—Sqn. Ldr. Thorn, by his personal example and untiring energy, has built his squadron into a highly efficient unit during the five months in which he has been its commanding officer. During the combined operations at Dieppe on August 19th, 1942, he displayed great courage and determination when under heavy fire from the ground defences, and he refused to be diverted from his task when warned that he was being attacked by an enemy fighter. The successes achieved by the squadron on this and other occasions have been primarily due to Sqn. Ldr. Thorn's gallantry and fine leadership, both in the air and on the ground.

Flt. Lt. I. H. EDWARDS, R.A.F.V.R., No. 19 Sqn.—This officer has completed numerous sorties over enemy-occupied territory. He has destroyed at least two enemy aircraft and damaged several more. Flt. Lt. Edwards participated with distinction in the recent combined operations at Dieppe.

Flt. Lt. W. GILMOUR, No. 156 Sqn.—One night in August, 1942, this officer was captain of the leading aircraft of a bomber force detailed to attack an objective at Kassel. Despite heavy anti-aircraft fire, Flt. Lt. Gilmour eventually identified his correct target, over which he released his flares with such accuracy that all following aircraft were enabled to bomb their objective successfully. Although his aircraft was badly damaged, Flt. Lt. Gilmour flew it back to base. He has participated in numerous sorties.

Act. Flt. Lt. L. D. BRITAIN, R.A.F.V.R., No. 25 Sqn.—Flt. Lt. Britain is an observer of outstanding merit. He has participated in the destruction of five enemy aircraft at night. He has assisted considerably in the training of other observers.

Act. Flt. Lt. S. R. EDNER, R.A.F.V.R., No. 121 (Eagle) Sqn.—This officer has participated in many operational sorties and has destroyed at least five enemy aircraft, a locomotive and three barges. Flt. Lt. Edner is a fine leader.

Act. Flt. Lt. J. SHEPHERD, R.A.F.V.R., No. 118 Sqn.—This officer has taken part in many sorties over enemy-occupied territory and in several reconnaissance missions and attacks on shipping. He has destroyed at least two enemy aircraft. In the combined operations at Dieppe, Flt. Lt. Shepherd assisted in the destruction of a Do. 217.

Act. Flt. Lt. H. E. TAPPIN, R.A.F.V.R., No. 3 Sqn.—Flt. Lt. Tappin, who was appointed flight commander in April, 1942, has participated in a number of hazardous operations. He led his squadron in the first sortie during the combined operations at Dieppe on August 19th, 1942, and although his aircraft was severely damaged, he returned to base safely. Flt. Lt. Tappin led the squadron in a further three sorties during these operations and despite the fierce enemy opposition he pressed home his attacks.

F/O. J. HENDERSON, R.A.F.V.R., No. 19 Sqn.—This officer has participated in numerous sorties over enemy-occupied territory and in several shipping reconnaissances and took part in the combined operations at Dieppe. He has destroyed one and probably another two hostile aircraft.

P/O. F. T. BROWN, R.A.F.V.R., No. 118 Sqn.—This officer has participated in a large number of operational sorties. He has invariably led his section with outstanding ability and has set an example which has done much to maintain the high morale of his fellow pilots.

P/O. R. J. MCNAIR, R.A.F.V.R., No. 87 Sqn.—This officer is a most capable operational pilot. In night-flying operations he has destroyed a He. 111 and probably destroyed two Ju. 88's. In the combined operations at Dieppe, his cool and courageous work set an inspiring example.

Act. Flt. Lt. C. H. DUNCAN, R.A.F.V.R., No. 24 (S.A.A.F.) Sqn.—Since operating in the Western Desert this officer has completed 115 hours operational flying. On numerous occasions his aircraft has been attacked by enemy fighters, but he has successfully driven them off. As gunnery officer he has carried out his duties most efficiently.

F/O. N. H. JOSLING.—Since his arrival in Malta this officer has performed his duties as an observer with much success. He has taken part in the destruction of four enemy aircraft at night. Previously in France, while employed as an air gunner, this officer probably destroyed two Me.109s.

F/O. P. MAINS-SMITH, R.A.F.V.R., No. 37 Sqn.—This officer has completed numerous long range sorties, including attacks in Libya, Crete, Greece and Tripolitania. Throughout, he has maintained a high standard of efficiency and devotion to duty. During recent attachment to Malta, and on several occasions when in charge of the forward party working from an advanced landing ground, his efforts contributed materially to the successes obtained.

F/O. C. L. ROMAN, R.A.F.V.R., No. 272 Sqn.—This officer has participated in operational flying over Norway, the North Atlantic, the Mediterranean and Libya. In Libya he has led a number of extremely effective low flying attacks on enemy airfields and other targets. During the course of these operations he has destroyed a Me.109 and probably destroyed three other enemy aircraft.

F/O. P. L. UNDERWOOD, R.A.F.V.R., No. 235 Sqn.—This officer is a most determined leader. He has taken part in all fighter escorts to cover Beaufort strikes from Malta. On June 21st, during a formation attack on an enemy merchant vessel (which was sunk), he destroyed two Ju.88s which attempted to attack. His skill and resource on this occasion contributed materially to the success of the operation. On June 23rd F/O. Underwood drove off enemy fighters over a convoy which was attacked by Beauforts near the Gulf of Taranto.

F/O. W. G. WATSON, R.A.F.V.R., No. 38 Sqn.—F/O. Watson is a competent and courageous captain of aircraft. One night in March, 1942, he captained an aircraft detailed to bomb Benghazi. After take-off extremely bad weather prevailed. F/O. Watson resolutely flew on, located the target and completed his bombing attack. On this occasion information was particularly wanted regarding shipping in Benghazi harbour. After his attack, F/O. Watson made six runs over the harbour at a low height to obtain the required information.

Lt. M. DUFF-RICHARDSON, S.A.A.F., No. 4 (S.A.A.F.) Sqn.—This officer has at all times proved himself to be a cool and reliable pilot. On April 11th, 1942, the squadron, comprising seven Tomahawks with Lt. Duff-Richardson as

Sgt. I. G. Medwin of the Royal New Zealand Air Force, wearing the flying boot which he acquired in Egypt by walking back to our lines after being shot down in a raid.

leader of a section of four of them, encountered a force of 20 Stukas escorted by 10 fighters. Having become separated from his leader's section, he was first to observe the enemy force and went straight in to a head-on attack, forcing the enemy to jettison their bombs and further adding to their confusion by a succession of determined attacks. Eventually Lt. Duff-Richards was seriously wounded and crash-landed near the scene of the engagement, but by his initiative and gallantry successful bombing by a large enemy force had been frustrated. In this engagement Lt. Duff-Richardson destroyed one Me. 109F, one Ju. 87, and damaged two Stukas. Previously in November, 1941, this officer destroyed a Me. 110 and assisted in the destruction of a Cant 1007 in January, 1942.

Lt. N. A. MCGREGOR, S.A.A.F., No. 24 (S.A.A.F.) Sqn.—Lt. McGregor has served in both Nos. 12 and 24 squadrons, and has completed many long-distance reconnaissance flights. He has proved himself to be an observer with exceptional skill, and he has led numerous successful and difficult bombing raids where, at times, the targets were within two miles of our own troops.

Lt. D. MCPHERSON, S.A.A.F., No. 24 (S.A.A.F.) Sqn.—This officer has completed numerous successful bombing raids and long-distance reconnaissance flights. On December 10th, 1941, he was the only survivor of a Boston aircraft which was shot down in flames. Undaunted, he continued on operations.

Lt. E. C. SAVILLE, S.A.A.F., No. 2 (S.A.A.F.) Sqn.—This officer has shown outstanding leadership and courage in combat against the enemy. His conduct throughout has proved invaluable to younger and less experienced pilots, who have recently joined the squadron. Lt. Saville has destroyed five, probably destroyed two, and damaged three enemy aircraft.

P/O. A. M. BEACH, R.C.A.F., No. 104 Sqn.—As navigator and bomb-aimer, this officer has participated in numerous sorties against targets in Germany, France, Belgium, Italy, Tripoli and Cyrenaica. Whilst based in this country, he took part in the first daylight attack on the battle cruisers at Brest. During the engagement his gunners shot down an enemy fighter. During his operations in the Middle East, P/O. Beach has maintained his very high standard of navigation and bomb-aiming.

P/O. G. C. COWARD, R.A.A.F., No. 3 (R.A.A.F.) Sqn.—This officer has proved himself to be a most reliable and experienced pilot. Since joining this squadron he has completed many sorties and has destroyed two enemy aircraft. During the fighting from May 25th to June 1st, 1942, when this squadron was engaged on dive-bombing and machine-gunning activities, P/O. Coward participated in four successful sorties. Pressing home his attacks with great determination and courage, he inflicted extensive damage on equipment and troops.

P/O. A. C. HARDY, R.A.A.F., No. 148 Sqn.—This officer is an exceptionally competent navigator and bomb-aimer. Unperturbed in the face of any danger, no untoward incident has ever deterred him from flying or diminished his enthusiasm. P/O. Hardy has completed several attacks on Comiso. This officer has on several occasions flown with a new crew on their first flight, giving valuable instruction and inspiring confidence. His general knowledge of the technical side of Wellington aircraft has on several occasions been responsible for the success of an operation when difficulties have been encountered.

P/O. C. D. HARRIS-ST.-JOHN, R.A.F.V.R., No. 140 Sqn.—In August, 1942, this officer was de-

tailed for a low-level photographic reconnaissance over Dieppe. A large-scale operation depended upon the results which must be obtained at all costs. On the outward fight weather over the Channel was very bad with heavy rain and poor visibilty; at times, P/O. Harris-St.-John was forced down within 30 feet of the sea. When within three miles of the enemy coast visibility became clear and P/O. Harris-St.-John found himself heading straight for Dieppe at 100 feet. There was no cloud cover nearer than 12,000 feet, but, fully alive to the importance of his mission, he decided to fly straight ahead at only 100 feet.

Whilst still a mile from the objective, the defences opened fire, but he courageously pressed on and flew right in over the harbour mouth in the face of intense light anti-aircraft and machine-gun fire. He took exposures of the barbour and docks flying only just high enough to clear the house-tops. His aircraft was hit by a shell which blew a hole twelve inches square in the starboard main plane and splintered the engine cowlings. P/O. Harris-St.-John was now inland with the nearest cloud cover some three miles cut to sea. Displaying great resource, he dived towards the coast-line, opening fire on the nearest gun emplacement to cause confusion, thus he was able to fly out to sea and reach the safety of the cloud cover.

His photographs of the objective were first class and provided Combined Operations with extremely valuable information.

P/O. F. MACK. TWEMLOW, R.A.A.F., No. 250 Sqn.—This officer has worked extremely hard during a long period of operations in the Western Desert. He has participated in many ground machine-gunning sorties. On two occasions, during a recent battle, he dived very low in the face of heavy fire from the ground to machine-gun enemy troops and concentrations of enemey vehicles. He has participated in bomber escorts and fighter sweeps. This officer has led the flight with great ability and has destroyed four enemy aircraft.

W/O. D. W. BRYANT.—As navigator, W/O. Bryant has completed a number of sorties in the most arduous circumstances. He has displayed outstanding keenness and devotion to duty in work calling for the highest proficiency.

W/O. G. W. KUSIAR, R.C.A.F., No. 108 Sqn.—W/O. Kusiar joined the squadron at the time of its formation in August, 1941, when he took charge of air crews and performed excellent organising work. Since the squadron became operational he has displayed great skill and coolness in the face of heavy opposition. His accuracy of bombing has produced some very fine results, whilst his navigation has always been of the highest standard, particularly his astro-navigation. In many instances, in very bad weather, his skill had enabled him to locate his target.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. J. W. BROOKS, No. 174 Sqn.—Flt. Sgt. Brooks has completed 32 operational sorties. These operations have included high and low level raids and dive bombing attacks against industrial installations, airfields and sea ports. He also participated in the combined operations at Dieppe on August 19th, 1942.

Sgt. R. G. BELL, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—One night in August, 1942, this airman was pilot of an aircraft detailed to attack Duisburg. Whilst over the target area, his aircraft was attacked by an enemy fighter from close range. Diving steeply, Sgt. Bell evaded further attacks, but his aircraft had sustained extensive damage. The elevators, the port aileron and fuselage were all pierced; the port petrol tanks were riddled, while the hydraulics were shot away and one of the gun cupolas was smashed. The first wireless operator was injured and Sgt. Bell was badly cut in the right hand by splinters. Despite this, he made another run over the target and bombed it. Shortly after leaving the target area one of the engines failed and the aircraft spun towards the ground. Sgt. Bell, however, skilfully regained control and eventually flew his damaged bomber back to an airfield in this country where he executed a skilful crash-landing. In the face of harassing circumstances, this airman displayed great courage and devotion to duty.

Flt. Sgt. G. P. A. YATES, R.C.A.F., No. 40 Sqn.—One night in August, 1942, Flt. Sgt. Yates captained an aircraft detailed to attack shipping in Tobruk harbour. On the outward flight, when some 60 miles from the target, serious engine trouble developed. Despite this, he flew on and released his bombs alongside the jetties where a large explosion occurred. On the return journey, engine trouble continued and one of the propellors dropped off. The aircraft rapidly lost height and, although movable equipment was jettisoned, it was not possible to regain height. After ordering his crew to abandon the aircraft by parachute, Flt. Sgt. Yates flew on alone. Presently, the engines ceased entirely and he was forced to leave by parachute. Throughout, this airman displayed great skill and courage, while his efforts to save his aircra't were worthy of high praise.

Flt. Sgt. H. J. WELLARD, R.A.F.V.R., No. 38 Sqn.—As air gunner Flt. Sgt. Wellard has displayed skill and keenness which has won the confidence of the crews with whom he has flown. The meticulous care with which he prepares his guns and turret for operations is a fine example to all gunners.

Flt. Sgt. (now P/O.) J. T. WILLIS, R.A.F.V.R., No. 14 Sqn.—Throughout this airman has displayed great skill and determination. On several occasions he has successfully completed a bombing mission in extremely bad weather. One night in February, 1942, whilst bombing Martuba landing ground, his aircraft was severely damaged by anti-aircraft fire which rendered the fore and aft control useless. By a brilliant and determined effort he succeeded in flying back to friendly territory before he and his crew were compelled to abandon the aircraft and escape by parachute.

Sgt. K. R. BOOTH, R.A.F.V.R., No. 203 Sqn.—On May 28th, 1942, Sgt. Booth, as captain of aircraft, was patrolling the Eastern Mediterranean more than 300 nautical miles away from friendly territory when an enemy convoy escorted by Italian naval units and Ju. 88 aircraft, was observed. Immediately after passing information to base, and while still in close proximity to the enemy, one engine of his aircraft ceased to function. Despite this, no distress signals were made until he knew his previous information was in possession of base.

Sgt. K. J. COLE, No. 230 Sqn.—This airman is employed as fitter and engineer/air gunner on a Sunderland aircraft. He has participated in valuable reconnaissance and anti-submarine patrols, and, by his skill and resource, he has played a good part in the successes obtained. During the evacuation of British forces from Crete and Greece he performed excellent work. The unfailing serviceability of his aircraft under difficult conditions has been largely the result of his untiring efforts. The air crew, of which he was a member, have been responsible for the destruction of three enemy fighters in aerial combat and carried out several attacks on hostile submarines.

Sgt. (now P/O.) J. G. CRESWELL, No. 39 Sqn.—This airman has always shown the greatest keenness and devotion to duty. His accuracy of observation has been of the greatest assistance to his pilot.

Sgt. R. E. FORD, R.A.A.F., No. 14 Sqn.—As wireless operator/air gunner, Sgt. Ford has at all times shown outstanding keenness and skill. On several occasions the aircraft in which he has flown has been attacked by enemy fighters. One or more of the attackers have been damaged by his guns.

Sgt. L. E. MACADAM, No. 70 Sqn.—This airman has completed his operational tasks in a courageous and determined manner, often in the face of heavy opposition. His fine fighting spirit and cheerfulness, whatever the circumstances, have inspired his comrades to emulate his example.

SERVICE AVIATION

Roll of Honour

Casualty Communiqué, No. 163

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Royal Air Force

KILLED IN ACTION.—P/O. J. Abberton; Sgt. R. K. Ayres; Sgt. D. J. H. Beston; Flt. Sgt. E. W. Bristow; Sgt. P. Busby; P/O. E. A. Cassidy; Sgt. W. M. Crane; Sgt. P. G. Foster; Sgt. V. C. Fretter; Sgt. H. Garcia; P/O. J. S. Gilby; Sgt. D. J. Godfrey; Sgt. J. B. Hammond; Sgt. H. R. Harrison; Sgt. J. H. Jeffrey; Sgt. T. A. Miles; Sgt. A. W. Mount; Sgt. B. F. Quinn; Sgt. G. K. Sampson; W/O. G. A. Sanderson; Sgt. L. R. Silver; Sgt. K. W. Stevens; Sgt. J. Taylor; Sgt. R. D. Tree.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. A. E. J. Bourner; Sgt. P. L. Chapman; P/O. C. H. Curtis; Sgt. F. E. Dunn; Sgt. B. H. Forster; Sgt. A. H. Hancox; Flt. Sgt. B. M. S. Henderson; Sgt. H. W. Mantle; Sgt. W. Oates; Sgt. P. G. Pearce; Sgt. H. L. Price; Sgt. R. Rust; Sgt. H. Selby; Sgt. G. V. Smith; Sgt. A. S. Spackman; Sgt. C. L. A. Thompson; Sgt. T. H. Trinder.

WOUNDED OR INJURED IN ACTION.—Sgt. J. F. Macpherson; Sgt. J. W. Strain.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. S. Walker.

MISSING, BELIEVED KILLED IN ACTION.—Act. Sqn. Ldr. P. H. Foster; Sgt. J. C. Lee; Flt. Sgt. I. Rutherford; P/O. P. A. Worth.

MISSING.—Sgt. A. Allsopp; Sgt. E. W. Barfield; Sgt. H. Boardman; Sgt. E. R. Borsberry; Sgt. R. S. Brandish; Sgt. D. A. Clephane; Sgt. J. Coy; F/O. F. M. Davis; Sgt. W. H. Day; P/O. R. C. Eldridge; P/O. C. MacG. Farquharson; Sgt. G. Flint; Sgt. R. F. G. Grant; Sqn. Ldr. N. D. Guthrie; P/O. D. W. Hales; Sgt. L. Hammond; P/O. L. Harvey; Sgt. R. K. Holyer; Sgt. R. D. Horder; Sgt. J. Howarth; Sgt. M. G. Killingbeck; Sgt. N. Jackson; Sgt. F. H. Le Vack; Sgt. J. McL. McIntosh; Sgt. V. S. Mason; Sgt. J. Moore; Act. Flt. Lt. F. G. Neate; Act. Wing Cdr. R. H. Niven, D.F.C.; Sgt. P. F. O'Shea; Act. Flt. Lt. D. A. Parkins, D.F.C.; Sgt. J. G. J. Parrott; Sgt. J. E. Percival; Act. Sqn. Ldr. G. A. Powell, D.F.M.; Flt. Sgt. R. J. Preston; Sgt. P. C. Robson; Sgt. K. E. Savage; Sgt. A. G. Silvester; Sgt. T. C. Stobie; P/O. L. B. Thomas; Sgt. A. F. Towler; P/O. P. Walker; Sgt. H. Windle; Sgt. B. T. J. Woodland; Sgt. H. Unsworth; W/O. C. R. H. Underwood; Sgt. K. J. Yates.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. F. R. Hancock; F/O. J. D. B. Rigby; Sgt. B. F. C. Rixon.

KILLED ON ACTIVE SERVICE.—F/O. S. E. Andrews, D.F.M.; L.A/C. A. E. Ayling; Sgt. H. L. Baker; Sgt. J. G. Barlow; Act. Sgt. J. Bonner;

Rear Admiral C. Moody addressing cadets at a passing-out parade on the quarterdeck of H.M.S. *Gosling*.

SERVICE AVIATION

Sgt. D. E. Bottomley; Sgt. J. E. Browning; Sgt. M. A. T. Burns; Sgt. L. Callow; Sgt. G. E. Carden; Sgt. D. C. Collins; Sgt. M. L. Donohoe; L.A/C. C. E. Gray; P/O. J. A. Hill; Sgt. A. E. Harrison; L.A/C. G. W. Holt; Sgt. S. J. Hucklesby; Sgt. E. P. Monaghan; Sgt. E. Newcombe; Sgt. C. H. J. Noad; Sgt. C. A. Pankhurst; Sgt. A. P. Paterson; Sgt. P. J. Quigley; Flt. Sgt. D. N. Rains; L.A/C H. Riding; L.A/C. J. G. Riley; Sgt. G. Rosenthal; Sgt. R. E. Simkin; Flt. Sgt. L. M. Smith; L.A/C. W. J. Stonebridge; Sgt. J. M. Thompson; Sgt. J. Unwin.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. M. E. C. Bird; Sgt. F. Coakley; P/O. J. M. Joyce-Clarke; Sgt. J. B. Riley; Sgt. M. York.

WOUNDED ON ACTIVE SERVICE.—Sgt. D. Crompton; A/C.1 G. R. Hagan; Sgt. C. M. Harris; Sgt. E. J. Higginson; L.A/C. W. A. Howat; L.A/C. D. L. Kidgett; A/C.1 R. Millership; Sgt. G. W. Robins; P/O. L. W. White.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. A. E. T. Lockhart.

DIED ON ACTIVE SERVICE.—A/C.1 W. Ashton; A/C.1 J. Cranston; A/C.2 T. A. Evans; A/C.1 F. E. Gage; L.A/C. C. J. Harris; A/C.1 L. Heeley; L.A/C. R. Lawson; Cpl. R. M. McNeill; A/C.2 N. E. Miller; L.A/C. M. E. Nicholls; L.A/C. F. O'Brien; Flt. Sgt. N. E. Ray; A/C.2 J. Rogers; A/C.1 R. C. Rogers; L.A/C. P. Yates.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—A/CW.2 V. E. Roberts.

DIED ON ACTIVE SERVICE.—A/CW.2 G. M. Davies.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Sgt. P. Bell; Sgt. D. F. Capel.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. W. Chapman; Sgt. J. M. Emery Sgt. A. H. Ferguson; Sgt. O. W. McLean.

WOUNDED OR INJURED IN ACTION.—Sgt. D. W Beattie.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. B. G. P. Balleine; F/O. T. H. Bourke; Sgt. R. P. Davis; Act. F/O. W. M. Murphy.

MISSING.—Sgt. A. F. Ada; P/O. L. P. Hancock; P/O. D. J. Richards.

KILLED ON ACTIVE SERVICE.—Sgt. B. H. Barton; Sgt. C. T. McLoughlin.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. E. R. Parke.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. A. E. Browes.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. McCausland, Sgt. F. W. Nixon.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. W. E. Egri.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. J. Beaupre. Flt. Sgt. J. M. Jamieson.

MISSING.—Sgt. J. T. Avedisian; Sgt. R. B. Ayers; Sgt. J. B. Campbell; Sgt. J. R. Collins; Sgt. J. S. Evans; Act. Flt. Lt. R. R. Graham; Sgt. T. A. Harp; Sgt. R. G. R. Hodges; Sgt. G. W. Jewell; Sgt. P. E. Johnson; Sgt. E. J. Leblanc; Sgt. J. J. Matthew; P/O. J. J. Reilly; Sgt. R. A. Russell; Flt. Sgt. M. A. Schofield; Sgt. V. L. Simonson; Sgt. W. H. Treadwell; Sgt. E. L. Wagner; Sgt. E. G. White.

KILLED ON ACTIVE SERVICE.—Sgt. R. P. Davies; Sgt. W. P. James; P/O. R. B. McIntyre; Sgt. R. L. Mellish; Sgt. J. H. O'Connor; Flt. Sgt. J. P. Speakman; Flt. Sgt. E. A. Russell; Flt. Sgt. J. H. A. Ryan; Sgt. C. Torunczuk; Sgt. H. H. Way.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. H. J. Kelley.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. J. L. W. Mackenzie.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. B. W. McClennan.

DIED ON ACTIVE SERVICE.—Sgt. A T. Morgan.

Royal New Zealand Air Force

KILLED IN ACTION.—Flt. Sgt. N. R. Rowe.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. S. W. S. Beedie; Sgt. W. N. Hendry; P/O. N. F. McLean.

MISSING.—Sgt. T. S. Barclay; Sgt. R. H. Brisco; Sgt. G. E. Caitcheon; Sgt. A. Cabpbell; Sgt. R. F. Davis; Sgt. W. G. L. Inglis; Sgt. H. W. Sampson; Sgt. S. H. Schofield; Sgt. R. J. Warring; Flt. Sgt. V. K. Westerman; Act. Flt. Lt. P. J. Wilson.

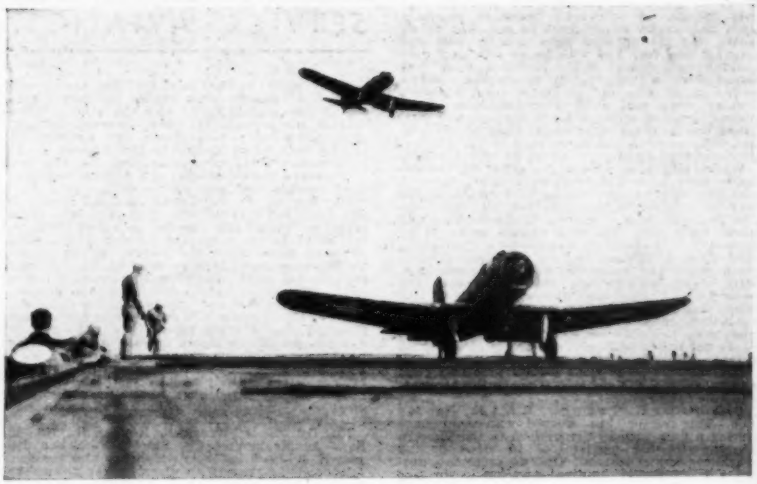
KILLED ON ACTIVE SERVICE.—Sgt. W. S. Burns; Sgt. A. L. Hopkins.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. J. A. McIntosh; Sgt. T. O'Meara; Sgt. T. K. Paul.

South African Air Force

KILLED ON ACTIVE SERVICE.—Lt. D. Geddes; Lt. W. H. Martin.

WOUNDED OR INJURED ON ACTIVE SERVICE.—2/Lt. R. E. Lefeuvre.



Vought-Sikorsky V-156 Chesapeake dive-bombers landing on a U.S. Navy aircraft carrier. The Chesapeake can carry either one 1,000 lb. bomb, two 500 lb. bombs, or four 116 lb. bombs.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Lt. F. C. P. Swart.

Casualty Communiqué No. 164.

Royal Air Force

KILLED IN ACTION.—L.A/C. M. Bray; Sgt. N. D. Fairclough; L.A/C. R. Garmory; Sgt. T. W. Hirst.

WOUNDED OR INJURED IN ACTION.—P/O. F. W. Kefford; Sqn. Ldr. H. C. Kennard, D.F.C.

MISSING, BELIEVED KILLED IN ACTION.—P/O. R. A. Hanagan.

MISSING.—Sgt. J. C. Aldred; Sgt. P. Barr; Sgt. R. Bell-Berry; Sgt. E. Bradley; Sgt. P. C. J. Brain; Sgt. J. L. Brydon; F/O. S. C. Bushell; Sgt. R. W. Butler; Sgt. J. R. Campbell; Sgt. E. Cartwright; Sgt. L. Causley; P/O. P. S. Champion-Jones; Sgt. H. F. Clarke; P/O. O. H. Clement; Sgt. G. Clerides; Sgt. J. Colville; Sgt. H. Condron; P/O. G. F. R. Cooke; Sgt. G. L. Cooper; Flt. Lt. A. W. Court; Sgt. J. Coweu; P/O. A. C. Crofton; Sgt. J. Culley; Sgt. J. T. Davidson; Act. Sqn. Ldr. W. T. Davies, D.F.C.; P/O. H. F. Deck; Sgt R. A. H. Dolan; Sgt. S. Duckworth; Sgt. G. McK. Duff; Sgt. J. Duthie; Sgt. G. L. Eke; Sgt. A. S. C. Ellis; Sgt. A. D. Evans; Sgt. W. D. Evans; Flt. Sgt. G. C. Everitt; Sgt. G. L. Ferry; Sgt. E. Forman; Flt. Sgt. L. S. Franklin; Sgt. D. Freeman; Sgt. F. A. Frost; Sgt. C. N. Gardner; Sgt. L. A. L. Gray; Flt. Sgt. T. M. Gray; P/O. E. W. Grundy; Sgt. W. Hallyburton; Sgt. H. J. Hannaford; P/O. H. W. Harrison; P/O. A. S. Hawkins; Sgt. K. Hayworth; Sgt. J. W. E. Holland; P/O. F. C. Holloway; P/O. F. A Hurlev; P/O. C. E. Hurt; Act. Flt. Lt G. A. Ings; Flt. Sgt. W. A. L. Ireland; Sgt. J. L. Johnson; Wing Cdr. C. H. Jones, D.F.C.; Flt. Lt. H. M. Jones; Sgt. O. Kedgley; Flt. Sgt. G. Kelly, D.F.M.; P/O. R. R. Kemp; Sgt. E. H. Kerry; Sgt. E. G. Kershaw; Sgt. E. J. King; Flt. Lt. C. C. King; Sgt. R. H. Lowe; Sgt. I. D. Lowther; Sgt. G. E. B. Luckman; Sgt. R. G. McCrory; Sgt. J. McI. McMahon; P/O. J. R. Mace; Sgt. D. R. Manser; Sgt. R. A. Mansell; Sgt. D. W. Mathieson; Sgt. D. E. G. Merritt; Sgt. L. G. Millar; Sgt. R. A. Milner; Sgt. P. Milnes; Sgt. W. H. Mitchell; Act. Flt. Lt. A. G. de B. G. Monk; Sgt. C. H. Moody; Sgt. D. W. Moss; Sgt. R. North; Sgt. D. L. Osborne; Flt. Sgt. J. Owen; Sgt. L. E. B. Oxley; Sgt. G. C. Padkin; Sgt. R. A. Parsons; W/O. A. S. Patterson; Sgt. D. C. Porter; P/O. T. W. Prentice; Act. Wing Cdr. H. L. Price, D.F.C.; Sgt. J. A. Rice; Sgt. P. Rix; Sgt. R. L. Rodwell; P/O. H. M. Russell; Sgt. W. McP. Samuel; P/O. A. E. Shackleton; Flt. Sgt. A. J. Shirm; Sgt. F. Skelley; Sgt. D. Smith; Sgt. W. R. Smith; Sgt. G. R. S. Spencer; P/O. W. G. Sprake; Act. Sgt. D. F. Station; Sgt. H. McL. Stokes; Sgt. J. K. Stone; Sgt. J. E. Sullivan; Sgt. R. S. Tadman; Flt. Sgt. N. Tetley; Sgt. P. E. Thomas; Sgt. D. Thornton; Sgt. G. E. Tilling; Sgt. C. E. Tipper; Flt. Lt. E. Walker; Sgt. M. W. Walsh; P/O. B. N. Ward; Sgt. W. S. Warren; Flt. Sgt. K. M. Waylett; F/O. L. L. Whitaker; Sgt. J. Whalley; P/O. A. C. Whyte; Flt. Lt. J. C. M. Wilson, A.F.C.; Sgt. G. B. Wood; Sgt. P. T. Wright; P/O. N. D. Young.

KILLED ON ACTIVE SERVICE.—L.A/C. C. K. G. Bowery; Cpl. E. S. J. Brett; Flt. Lt. F. Brown; Sgt. S. Coates; L.A/C. S. R. Fenn; L.A/C. M. S. Gaskill; A/C.2 D. A. R. Hayley; L.A/C. R. Jones; Flt. Sgt. D. R. Lord; L.A/C. H. D. McCallum; Sgt. J. F. Mayhew; Sgt. A. L. Osborne; Sgt. H. W. E. Packham; Sgt. A. Page; Sgt. S. J. Palandri; Sgt. A. O. Potts; Act. F/O. E. T. Sellick, D.F.C.; F/O G. F. Sellick; Sgt. T. R. Thompson; A/C.2 R. F. Umney; L.A/C. B. H. Welsh; Sgt. D H. Weston.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Lt. T. R. Burne; L.A/C. T. W. Crowden; A/C.1 A. Hughes; Sgt E. W. E. Jones; Sgt. J. A. Jones; A/C.2 J. G. Littlechild; Sgt. A. S. Milton; Sgt. J. E. Parker; L.A/C. R. R. Reader; Sgt. R. J. Stephenson; Flt. Sgt. B. W. Webb.

DIED ON ACTIVE SERVICE.—L.A/C. R. Bassett; Sgt. R. B. Blockley; L.A/C. A. W. Crussell; W/O. G. Goldsborough; Cpl. J. W. Montgomery.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. N. G. Potter; Sgt. V. H. Rainbow; Sqn. Ldr. I. G. Richmond, D.F.C.; P/O. F. E. Scott.

Royal Australian Air Force

MISSING.—Sgt. R. C. Allan; Sgt. G. J. Bailey; Sgt. J. T. Bray; Sgt. N. C. Hain; Sgt. W. G. Hawes; Sgt. S. L. Hore; Sgt. C. P. Jenkins; Sgt. N. K. Judd; Sgt. C. C. McPherson; Sgt. M. R. Morey; Sgt S. A. G. Priestly; Sgt. O. L. Sharpe; Sgt. K. H. Shoesmith; F/O. J. L. Tully; Sgt. T. L. Vinnicombe; F/O. F. W. Weekes; Sgt. J L. Wilson.

KILLED ON ACTIVE SERVICE.—Sgt. C. E. Raison.

Royal Canadian Air Force

MISSING.—P/O. F. E. Anderson; Flt. Sgt. T. C. Blair; Sgt. I. B. Caryll; F/O. C. D. R. Chappell; Flt. Sgt. J. C. Chisson; Sgt. G. M. Clarke; Sgt. R. J. Edgar; Sgt. E. B. Egan; Sgt. J. A. Elmslie; Sgt. D. Fenton; Sgt. H. G. Graham; P/O. C. E. L. Hare; Sgt. D. B. Henshaw; P/O. J. G. Hudock; Sgt. R. C. Hughes; Flt. Sgt. A. T. Johnstone; Sgt. J. R. Kennedy; Flt. Sgt. H. N. Law; Sgt. S. R. Lupton; Sgt. W. G. McKinnon; Sgt. W. V. McQuaid; Sgt. W. F. Penney; Sgt. J. J. Price, Flt. Sgt. D. G. Reid; Flt. Sgt. V. N. Salmon; Flt. Sgt. W. J. A. Shapten; P/O. A. Smith; Flt. Sgt. J. M. M. R. Theberge; P/O. J. R. Tucker.

KILLED ON ACTIVE SERVICE.—F/O. A. J. Marsh.

Royal New Zealand Air Force

MISSING.—P/O. S. G. Brannigan; P/O. M. E. Carncross; P/O. H. D. J. Fitzsimmons; Sgt. P. J. Hooper; Flt. Sgt. G. A. Hutt; P/O. R. S. Lees; Sgt. J. G. McMurchy; Sgt. W. C. O'Shea; Sgt. C. G. Pullen; Sgt. J. D. Robb; P/O. N. B. Robertson; Sgt. J. H. Savage; P/O. I. J. Shepherd; P/O. J. G. Stewart; Sgt. A. C. Williamson; Sgt. J. F. Winstanley.

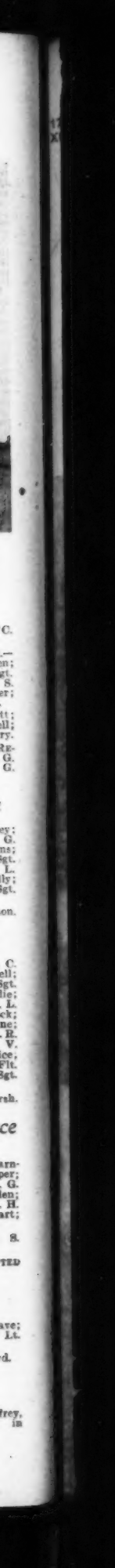
KILLED ON ACTIVE SERVICE.—Sgt. D. R. S. Dixon; Flt. Sgt. L. H. R. McCarthy.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. W. W. Hollands.

South African Air Force

MISSING.—Lt. W. P. Colman; 2/Lt. B. J. Grave; Air Sgt. S. Hughes; Air Sgt. A. L. Robinson; Lt. H. C. Warren.

KILLED ON ACTIVE SERVICE.—Lt. W. B. Boyd.

Official Correction

It is regretted that Sgt. H. E. W. Godfrey, R.A.A.F., was erroneously reported killed in action in Casualty Communiqué No. 156.